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THE TELEPHONE INDUSTRY.

The statistics presented by President Fish in the annual report of the parent Bell telephone corporation are really quite remarkable in their revelation of the growth and magnitude of the telephone industry in the United States. The Bell system alone earned $114,000,000 last year; and our estimate in these columns in January for all systems was $165,000,000, which would leave about $51,000,000 as the earnings of the "independents," a figure more likely to be an under-estimate than extravagant. Hence it would appear that the annual expenditure in the United States for telephone service has now reached $2 per person, including every man, woman and child. There is one Bell subscriber to every 28 persons, and the average number of calls within the system is 64 per person.

The last authentic figures with which the present ones are comparable are those obtained by the United States Census Office for the year 1902. There were then 2,178,366 telephone subscribers in the country, of which the Bell system had 1,222,327 and the "independents" 956,039. To-day the Bell system includes by this report of 1906 no fewer than 2,727,289 stations of its own and 297,220 of sub-licensees, making a grand total of 3,068,833. If the "independents" have grown at the same rate since 1902 they also should have more than doubled, and might well muster 2,000,000 strong, which would give about 5,000,000 stations, or, roughly, subscribers, for the United States. Now some of the enthusiastic "independents" claim a larger number of stations than are included in the Bell system, but this may be seriously doubted. In fact, President Fish, in his report, meets this very point squarely and says: "The so-called independent telephone companies which are in competition with the Bell companies throughout the United States have, so far as can be learned, except in a few localities, made no relative gain." This is probably very near the truth, for while it admits growth it does not concede gain. In fact, at this moment a merger into the Bell system impends for a large part of the "independent" service, although it is still difficult to tell whether this is a casual incident or the beginning of the end. It would at any rate be interesting to have the next Government figures, which will be those for the present year.

Under any circumstances, the tremendous expansion shown by the industry must encourage every electrical engineer desirous to see the advance and development of the arts and sciences in which he is interested. Even should the rate of growth of last year not be maintained, it is evident that the telephone will more than keep pace with the population of the country, in its increase. Last year the manufacturing end of the Bell system turned out the enormous quantity of $70,000,000 of apparatus,

chiefly telephonic, and its managers hardly expect to repeat that performance this year. But even if they do not, all the shops will be busy and full of work, and all the exchanges will have more subscribers next January than they had last.

Motor Generators Versus Synchronous Converters.

Mr. Lincoln's brief for the synchronous converter presented last week before A. I. E. E. and printed in abstract elsewhere in this issue, is an interesting and careful, if not altogether convincing, summary in praise of things as they are standardized. The "rotary," to use its vernacular name, is undoubtedly a very efficient and useful piece of apparatus, which under favorable conditions gives admirable service. We can hardly agree, however, with some of Mr. Lincoln's estimates of its performance compared with its rivals. In particular we are strongly of the opinion that in point of reliability the synchronous converter, including its transformer outfit, has very little to brag about. Compared, for instance, with an induction-motor generator we should say that the rotary would be out of service two or three times as much instead of considerably less, and would be somewhat inferior even to the synchronous-motor generator. If properly installed and cared for any one of the machines, however, is reasonably reliable. As to efficiency, the synchronous converter unquestionably has the advantage, though the data in our possession would indicate that the difference is much less than that estimated by Mr. Lincoln, say, 4 or 5 per cent instead of 8 per cent. The motor-generators gain materially from the fact that they can be designed with a much freer hand and worked nearer maximum efficiency without taking undue chances with the commutation. For motor-generators put together from stock, Mr. Lincoln's figures would be more nearly correct, and this is possibly what he has in mind.

For railway service the synchronous converter serves admirably since it is relatively cheap and efficient, and exactness of regulation is of only limited importance. In lighting work, however, the inter-dependence between the direct current and alternating current ends of the synchronous converter is pretty nearly a fatal defect, as practice in this country tends to show. Abroad the synchronous converter has barely obtained a foothold in the electric lighting business for this very reason, and it is even hard pushed in other fields. The cascade converter with its facility of adaptation to circuits of moderately high frequency has much to recommend it in countries where 50 cycles is an ordinary periodicity, and is cheaper than the common forms of motor-generators in addition. The permutator, too, is another machine which must not be forgotten, since it has an efficiency which, particularly at low loads, quite outranks even the synchronous converter, rising, from the lists published regarding it, to 95 or 96 per cent. It does not look as though the last word had been said regarding converters by any means, even for railway service. In this country the active exploitation of the synchronous converter has actually controlled the standard frequency so that we find a very large number even of lighting plants worked at 25 cycles and getting back to workable conditions by using frequency changers. Abroad 50 cycles is the commonest figure, and at this frequency the synchronous converter is not exactly an alluring proposition. Add to this the question of regulation and it is easy to see why the motor-generator is a favorite. It is the very large amount of railway work to which the synchronous converter is excellently adapted that has given it in this country a vogue beyond what its general properties deserve.

The Teaching of Mathematics.

We are glad to find Prof. Perry again to the front with a heartfelt protest against old fogy methods. Every student of engineering has suffered through their persistence in the schools, and it is high time for a change. This is the twentieth century, not the eighteenth, and both matter and order in teaching should show signs of progress. A hundred and fifty or 200 years ago algebra and trigometry were recondite branches of learning adventured only by a few rare spirits; logarithms were far in the cloudlands of advanced learning, and even decimal fractions were not for the common herd. Arithmetic and Euclid formed the sum of the ordinary scholar's aspiration. Times have changed and the branches of mathematics then almost unknown have become the everyday tools which the engineer must learn to use in his trade; yet the old traditions persist in the schools and arithmetic and Euclid are scarcely better taught than they were a century gone. Arithmetic is the same old carnival of vulgar fractions and juggling with obsolescent weights and measures. On the whole it has even changed for the worse, since loath to put algebra in its proper place, the unprogressive pedagogues filled their text books with problems which required the operations of algebra without the advantage of its simple and direct methods. They even introduced garbled calculus and clumsy trigonometry in arithmetical guise.

To-day, the educational wiseacres who take themselves seriously and read papers on child-culture at one another have changed the place and kept the pain. They have made intellectual mush of the rudiments without giving the branches now necessary a chance. Prof. Perry holds as the result of bitter experience in university teaching, that time and energy should be economized by early teaching of the rudiments of mathematics as a whole. Algebra is far easier than complicated arithmetic and vastly more useful, since it renders complicated arithmetic needless. And algebra is the master-key to all that goes beyond since the chief difficulties, we might almost say the only ones, in advanced mathematics are algebraical. There is no good reason why the methods of algebra should not follow close upon a thorough grounding in the rudiments of arithmetic and take the place of much of the useless numerical gymnastics now given. In similar fashion the fundamental notions of calculus are simple and of easy application, and simple differential equations are no more difficult than much of the work now given in algebra. There is no reason if there is proper teaching, why a boy should not go up to the technical school with a thorough practical knowledge of algebra including simple calculus and differential equations, as well as with the usual geometry and trigonometry. As things now are, the average boy most often does not know enough algebra to use it with any ease, and is rarely sufficiently well grounded in arithmetic to make the simple calculations of physics and chemistry with facility and precision. Every college instructor in science could a tale unfold in this connection. The average elementary school lays on its knowledge in coats altogether too thin to wear well.

FORESTRY AND WATER POWERS.

It has, of course, been long known that denudation of any region tends to make the run off very irregular by destroying the natural sponge that exists under the protection of the forests. It has not been so clear until recently that the actual effect of the cutting away of forests has already made itself felt in a very serious manner. Gaugings of the Merrimac and some other New England streams have in late years shown a considerably decreased minimum flow, and also, as might be expected, somewhat more severe high water conditions. The recent report of the Pennsylvania Water Supply Commission emphasizes these facts in no uncertain way, indicating the same general situation with respect to the streams of that State. Cause and effect go together and there is no dodging the conclusion that deforestation very considerably injures the value of the streams affected as sources of power. The minimum flow of a stream measures the power which can be developed without auxiliary steam power or extensive storage, either of which is a costly addition to a power plant. The maximum flow is also a cause of anxiety as affecting the hydraulic works, and as very possibly cutting down output through backing up the tail water. These facts are sufficient to stimulate interest in forestry and to warrant the location of forest reserves about the headwaters of important streams. There is, however, another phase of the subject that deserves investigation as possibly leading to results still more serious than those ordinarily considered.

It is generally stated by meteorologists that the absolute rainfall is practically uniform when any long series of years is considered. It varies from year to year, even from decade to decade, but in the long run remains fairly constant. Is this conclusion warranted when deforestation is taken into account? The destruction of forest has been going on rapidly only in, say, the last thirty years. Will the rainfall conditions prior to that time be upon the whole repeated in the same districts? For example, let a mountain range near the coast be denuded, exposing its crest to unchecked heating by solar radiation. Will the air temperatures which determine the precipitation from inland bound currents remain sensibly the same as when the range was forested? Topographically there are reasons for supposing that considerable changes may be wrought. For example, the slopes of the Coast Range on the northern part of the Pacific Coast are regions of extreme rainfall, perhaps the heaviest in the country. The range here is still well wooded, but further south where there has been a large amount of natural denudation, the rainfall is slight. Again, in the southern part of the Green Mountains, which is still well forested, the rainfall is notably greater than elsewhere in the surrounding country. We have no thesis to set upon the matter, but merely suggest it as a subject decidedly worth investigating. In how far, if at all, does denudation affect local precipitation and tend to a redistribution of the total precipitation? Lessened rainfall in the mountains would greatly injure water powers even if the country as a whole obtained an undiminished amount. A permanent loss of precipitation is vastly more serious than any variations in run off. The subject is not an easy one to investigate because changes are slow and ordinary variations of rainfall tend to mask the more lasting changes; yet examination of the world's arid areas might give valuable hints as to the action that has gone on in centuries past.

22,000-VOLT GENERATORS.

At a meeting of the American Institute of Electrical Engineers held last week, Mr. B. A. Behrend presented an interesting paper, introducing a discussion on the feasibility of large generators wound for 22,000 volts. It was pointed out that the larger the size and output of an alternating-current generator, the higher the voltage that may be generated by it without employing small conductors, or many conductors per slot. The fact is that as the size of such generators has increased, there has been a rise in the generated voltage at terminals. The early 3500-kw Niagara machines employed 2200 volts, while some recent 7500-kw generators built for the Brooklyn Rapid Transit Company supply 11,000 volts. The paper estimates that in connection with the steam-turbine generators for large systems, the output of each machine will increase to 10,000 kw, or even to 25,000 kw, before very long. A 15,000-kw alternator might employ only six conductors per slot, if wound for 22,000 volts per phase. The extra voltage would not, therefore, increase the winding difficulties, but would only increase the insulation difficulties. An account was given of the behavior of a 150-kw, three-phase alternator wound for 25,000 volts, which has been operated day and night under full load for months. This is a machine which delivers 150 kw at a non-inductive current of less than four amperes per wire. The regulation of the machine under rated non-inductive load is stated to be 4 per cent. These facts indicate that it is quite possible to construct 22-kilovolt machines for outputs as low as 150 kw, and there would naturally be still less difficulty in building them for larger outputs.

When a generating station has to transmit power to a radius of only 10 miles at most, it is doubtful whether there would be any advantage in constructing the generators for more than 11 kilovolts. It is necessarily more expensive to build a 10,000-kw alternator for 22,000 volts than for 11,000 volts. The higher the voltage the less copper and the more insulation goes into the winding space of the armature. If, however, the generating station is called upon to transmit a large share of its power to distances from 10 to 30 miles, then there might be a considerable economy in building the alternators for 22 kilovolts, instead of 11 kilovolts or 5.5 kilovolts, because step-up transformers might thus be dispensed with. It is certainly less expensive to buy a 10,000-kw, 22-kilovolt generator than a 10-000-kw, 11-kilovolt generator, plus a step-up transformer of corresponding capacity. The 22-kilovolt installation must be purchased for the station, and if air-cooled transformers are contemplated, the coils might almost as safely, and certainly more cheaply, be placed directly on the stator of the generator. If, however, the generating station is called upon to transmit a large share of its power to distances beyond 20 or 30 miles, then step-up transformers will have to be used, and it would become cheaper to step-up from 11 kilovolts, instead of from 22 kilovolts. Steam plants, however, are not likely to be used for such very long transmissions. The principal opening for 22-kw alternators therefore seems to be for transmissions to a radius of 20 or 30 miles, in order to save step-up transformers. Otherwise, a lower voltage is likely to be preferred in generation.

Annual Statistics of Bell Telephone System.

The annual report of the American Telephone & Telegraph Company has just been issued and testifies to the extraordinary prosperity and development of the telephone industry in the United States during the past year. The gross revenue of the company for the year ended Dec. 31 last, amounted to $24,526,698, an increase of $2,813,267. Owing to substantial increases in operating expenses the net earnings increased only $63,101. After paying dividends there was left a balance of $2,775,704, of which amount $1,773,737 was carried to reserve and $1,001,967 carried to surplus.

The development of the system physically is indicated by the following table:

	1906.	1905.	1904.	1903.
Telephones Dec. 31.....	7,107,836	5,698,258	4,480,564	3,779,517
Exchanges and branch offices.	4,889	4,532	4,080	3,740
Miles aerial wire.....	2,754,571	2,183,167	1,654,379	1,358,140
Miles wire underground.....	3,241,471	2,585,742	1,888,760	1,618,691
Miles wire marine.....	11,690	9,373	6,671	6,358
Total miles wire.....	6,007,732	4,778,282	3,549,810	2,983,189
Number circuits.....	1,384,175	1,135,449	930,251	798,901
Number employes.....	90,324	74,718	59,451	53,795
Number stations.....	2,727,289	2,241,367	1,799,633	1,525,167
Number daily con.....	16,478,058	13,543,468	11,149,063	9,876,402

President Fish gives also a total of 297,220 exchange and toll stations operated by sub-licensees, "independent" companies, etc., making a grand total of 3,068,833 stations, as compared with 2,528,715 in 1905. The number of conversations was 16,940,000 daily, or 5,455,000,000 per year, being 64 calls annually per capita of the population. On Jan. 1, 1907, there was one Bell telephone subscriber to every 28 of the total population of the United States.

President Fish gives the gross income of the Bell telephone system of exchanges for the year as $114,000,000; and predicts better results for this year. The total does not include the $69,000,000 earnings from manufacture of the Western Electric Company, largely owned by the American Telephone & Telegraph Company. During the year, $59,971,094 was added for exchanges; $13,585,659 for toll lines; and $5,810,196 for land and buildings, a total of $79,366,949. In the last seven years this total is no less than $298,914,255. Mr. Fish says that the companies have proceeded upon a more definite theory of growth in the last year than they had been able to apply before. Moreover, better construction is having its effect. "Every circuit added to a pole line reduces the cost of the installation per circuit mile; and it is a satisfaction to know that the number of miles of wire per mile of pole line has increased from 5.6 on Jan. 1. 1900, to 9.4 on Jan. 1, 1907. For the year 1906, the increase in miles of pole line was 9,334, while the increase in miles of wire was 195,937, the ratio being more than 20 to 1."

Mr. Fish takes up the subject of rates and says:

"As stated in prior reports, the unintelligent views of our competitors as to what rates for service are possible have created conditions in the portions of the country to which reference is now made, under which neither they nor the Bell companies are getting proper returns for the service rendered. These conditions are sure to correct themselves in time, particularly as almost everywhere, except in some of the comparatively few places in which new promotion schemes are being exploited, our competitors have discovered their mistake and are as anxious to raise their rates as they formerly were to do business at a loss. We have now developed our plant, business and organization in most of these localities to such an extent as to have the situation in hand, and have now only to proceed on sound lines to establish such relations with the public as will enable us to secure a fair return for the service rendered. There are definite indications that the public in these localities appreciates the situation to a greater extent than ever before, and that it will ultimately co-operate to secure the adequate telephone service which it needs, by encouraging our companies to make the readjustment of rates that is necessary to enable us to give that service under fair conditions. In by far the greater part of the country, rates are established and maintained with the approbation of the public, which permit the reasonable return required by the Bell companies to enable them to meet the demands of those who use the telephone.

"Considering the difficulties in telephone rate making, and the fact that even now there has not been sufficient experience with the constantly changing phases of the business to make it possible to establish rigid theories fitting all conditions, it is a satisfaction to find that the complaints made as to the rates of the Bell companies are comparatively few in number, and are generally based upon some special feature of the system employed in a particular locality, and not upon the scheme of rates as a whole.

"The so-called independent telephone companies which are in competition with the Bell companies throughout the United States have, as far as can be learned, except in a few localities, made no relative gain. It is a matter of common notoriety that many of them recognize that their situation is unstable. Comparatively few new independent plants have been established in competition with the Bell during the past two years. A number of franchises for competing companies have been granted in various cities, but during the year 1906, and up to the present time in the year 1907, substantially no work has been done under any of the franchises in the more important places. The investors from whom independent telephone promoters have secured money in the past, are apparently less inclined than formerly to make the advances required to install telephone exchanges under the very unfavorable conditions, among others the excessive cost of material and labor and the high rates for money, which now prevail. The known financial situation of some of the larger independent enterprises undoubtedly also operates to check such investment."

Mr. Fish makes a brief statement in the report as to the steps taken by the company to finance itself during the year, $30,000,000 of the 4 per cent convertible $100,000,000 bonds having been taken and paid for. In January, 1907, also the company sold three-year 5 per cent notes to the amount of $25,000,000, and these were readily placed and the money used for the enormous demands of the industry.

American Museum of Safety Devices.

With the purpose of arranging the preliminary plans connected with the establishment of a permanent museum of safety devices in America, a dinner conference was held by Dr. Josiah Strong, as president, and Dr. W. H. Tolman, as director, of the American Institute of Social Service, at the Aldine Club, New York City, on Friday evening, March 22, at which a number of the leading editors and publicists of New York City were in attendance. The business portion of the evening was devoted to a discussion of the facts which render desirable the establishmen in this country of such a museum. It was stated that even in New York City alone, taking the statistics for certain years, an average of from 9 to 13 persons meet with violent death per day. Most of the accidents to which these deaths can be attributed are preventable by the use of proper safety devices.

It is the intention to establish in New York City a museum in which approved safety devices can be permanently located and to which the public will have free access at all times. In regard to such work it is worthy of note that the progress in this country has been very much less than that abroad. During the evening, lantern slides were shown of a considerable number of the great museums already established abroad, notably those at Amsterdam, Berlin, Paris, Madrid and Milan. It will be recalled that an exposition of safety appliances and industrial hygiene was held at the American Museum of Natural History from Jan. 29 to Feb. 12, 1907. At this exposition, marked interest was aroused in the general movement, and it is believed that the time is now ripe for making the exposition permanent. Present estimates seem to indicate that about $25,000 will be needed as the initial fund. About $1,500 has already been raised for this purpose, $1,000 of which has been pledged by the Non-Explosive Safety Naphtha Container Company, of New York. Subscriptions will be solicited from those who will profit from the application of safety devices, as well as from those who are interested in the movement from the humanitarian aspect. The *Scientific American* has announced its intention of presenting annually a gold medal to be awarded for the invention of the

best safety device, with the single suggestion that the medal in successive years should be given for inventions in widely differing lines. A pronounced step was taken in the organization by the appointment of an advisory committee consisting of the editors of the leading technical and trade journals.

German Patent-Office Decision on Invention of Mercury Vapor Lamps.

The German Patent Office has rendered a decision supporting the validity of a German patent granted in 1900 to Peter Cooper Hewitt on the principles of the mercury vapor lamp for illumination. Proceedings were brought by Hans Boas, of Berlin, to nullify the patent, and the report sustaining it is signed by Dr. Rhenins, president, and Prof. Dr. Nebel, Prof. Dr. Jaeger, Privy Councellor Berkenfeld and Dr. Mullendorf.

The report states that Cooper Hewitt was the inventor of the mercury arc lamp as an illuminating means. Arons and others had recognized that mercury vapors traversed by electric current lighted up, but they were not able to state how a commercially useful lamp could be made on this basis. Water-cooled vapor tubes described by Arons and Lummer were not useful as illuminating means, on account of the great heat made necessary by the shapes, which heat had been removed by water. It has not been established that Arons had considered the relations of temperature, current strength, potential, conductivity, vapor density, and heat radiation; nor where he had shown that it was possible, by using the laws of these phenomena and by a suitable choice of the dimensions of the glass vessel, to produce an illuminating means without water-cooling. Cooper Hewitt was the first who, by a special cooling-chamber, or by increasing the cross-section of the container inclosing the gas or vapor, did away with artificial cooling means, and the constructions cited by the plaintiff as anticipating the novelty, did not apply.

Even if it is allowed to the plaintiff that Cooper Hewitt was not thoroughly conversant with what took place in the mercury vapor lamp, and had not yet recognized which of the three potential drops was affected by the enlargement of the vessel, still he was unable to prove that at the date of the application for patent of 1900, electric lamps with conducting gas or vapor column were provided with such enlargements, and that the lamps could be kept cool without the use of special cooling means. The lamps of Arons and Lummer served exclusively for scientific researches and demonstrations, and required in addition water-cooling, and this is still necessary for the normal use of these lamps. Even if Arons may have used a lamp without water-cooling, the sealing points had to be protected against too great heating, by the immersion of the shanks of the apparatus in glasses containing mercury. Therefore, the water-cooling was replaced by mercury cooling, whilst the Cooper Hewitt lamp is kept cool without the use of special cooling means. This is the more noticeable, because here one of the electrodes is solid, whilst with the Arons lamp, with the exception of a single experiment, both electrodes consist of a liquid (mercury). Of the Arons experimental lamps, which possessed an actual gas or vapor column, the plaintiff had to admit that the lower electrode was formed by dipping tubes, open at the bottom, to different depths in a long vessel filled with mercury. In this case both a cooling effect and a pressure equalization were effected by the large quantity of mercury. Nowhere in the literature cited is it even hinted that one was dealing with a commercially useful illuminating lamp; and since the allegations of the plaintiff to establish the fact of prior public use do not refer to such a lamp, it was not considered necessary to examine Arons as a witness.

The reference to the enlargements in Geissler tubes is also erroneous. The enlargements were not attached to the capillary, as the plaintiff seems to believe, on account of the potential drop between electrodes and gas, but the capillaries were joined to the larger tubes, in order that the light for the spectral analytical investigations might be more concentrated. But however this may be, the enlargements in the Geissler and Röntgen tubes cannot be compared with those in mercury-vapor lamps, in which it is not a question of solid electrodes and a constant amount of gas under very slight pressure, but of a liquid electrode consisting of mercury, of which large quantities are evaporated. At any rate, it is not a case of a simple transfer to mercury vapor lamps of the enlargements known in Geissler tubes. Besides, the manometer used by Arons with his lamps cannot be considered as equivalent to the enlargements according to the Cooper Hewitt patent, because the manometer permits of an increase of the space, which, with a rigid formation, such as is represented by the Cooper Hewitt lamp, is not the case. Moreover, the manometer served actually only as a pressure gauge, and it was not in any way its purpose to dispense with the cooling apparatus for the lamps; for this was already present. But even if the similarity of the manometer with the enlargements in the Cooper Hewitt patent were admitted, still, in the omission of the manometer from the Cooper Hewitt lamps, an important technical simplification would be recognized, which, in practice and from a commercial point of view, exercises great influence, and for that reason alone would justify the granting of a patent. Furthermore, according to the claim, not every desired enlargement is the subject of the patent in controversy, but only such an enlargement as will make it possible to dispense with the special cooling-means. Moreover, Rapieff's lamp (1879) and that of Perot and Fabry (1899) do not come under consideration, because only small luminous arcs appear in these constructions, no gas or vapor columns being present, and because, on account of the plentiful amount of mercury, cooling takes place at the electrodes.

Meeting of the Illuminating Engineering Society.

A special meeting of the Illuminating Engineering Society was held in the United Engineering Building on Friday, March 22, for the purpose of listening to an address by Prof. O. Lummer, of the University of Breslau, who left for Germany the next morning. Prof. Lummer dwelt at length on the laws of radiation as applied to black bodies, and on the application of the laws to the determination of the temperature of bodies. He differentiated clearly between radiation from black bodies, selective radiation and luminescence, and also showed how the application of the laws of radiation affected the theory of the composition of the sun and other heavenly bodies and accounted for the formation of the tails of comets. The address was of a nature difficult to abstract and occupied almost all the evening. The short discussion was opened by Dr. Steinmetz, who was followed by Dr. Sheldon and Dr. Schniewind.

Electric Wave Detectors.

Brother Potamian has contributed the following interesting letter to the New York *Times*, in the columns of which journal there has been a discussion as to whether electric waves could have been the cause of the explosion on the French war vessel, the *Jena:*

"I happened to be at the Royal Institute, London, on March 8, 1889, on which occasion Prof. Lodge, of Liverpool College, now Principal of Birmingham University, gave a lecture on the discharge of a Leyden jar. I was sitting on one of the rear seats just under the gallery, and not far from the wall, which was covered with spangles of gilt paper. To my surprise, although working at electrical radiation at the time, I noticed that every discharge of the small Leyden jar on the lecture table, 600 feet away, was accompanied by sparks between the angles of the gilt spangles. The murmur due to our observation attracted general attention after a few minutes. Prof. Lodge looked up in my direction and soon recognized the cause of our local disturbance, when, with pardonable enthusiasm for one who is ordinarily so phlegmatic, he proceeded to speak the praises of the gilt spangles as wave-detectors."

New England Electric Lighting Engineers.

The fifth annual meeting of the Association of Electric Lighting Engineers of New England was held at the American House, Boston, March 20. Mr. Geo. R. Stetson, of New Bedford, occupied the chair on account of the illness of President Woodward. About 100 members and guests were present.

The first paper presented was on "Automobiles in Central Station Practice," by Mr. D. F. Burritt, of the Springfield Gas Light Company, Springfield, Mass. Mr. Burritt stated that his company owns and operates five automobiles. One is a 9-hp gasoline runabout; the second is an 8-hp delivery car with 1200-lbs. capacity; the third is a 16-hp, double-cylinder delivery car with a capacity of 2500 lbs.; and the fourth is a 24-hp heavy truck, having a capacity of 6000 lbs. The runabout is constantly in use by canvassers and patrolmen, and it made 6583 miles in 1906, giving little trouble in bad weather or on poor roads. Traction chains were used on the tires in the winter. The 2500 lb. car has been in use for three years, and last year the cost of repairs was less than 1 cent per mile. It is used by metermen, repair and trouble men and is on duty from 7 a. m. till late at night. It replaces two good single teams and has a maximum speed of 15 miles per hour, but its single cylinder is a disadvantage and the machine is somewhat weak on stiff grades. The double-cylinder machine of 16-hp has carried loads of 3000 to 3600 lbs. frequently, and with the thermometer at 90 degrees has hauled 3400 lbs. of coke 7 miles into the country and returned inside of an hour. The machine has a good light-load economy, will make 18 miles per hour maximum speed, and in 1906 ran 6181 miles. The heavy truck has carried 8000 lbs. frequently, and is largely used in delivering cast-iron pipe, coke and other heavy materials. It is specially useful in transferring gangs of workmen and tools from one place to another with rapidity. Its maximum speed is about 15 miles per hour.

A novel application of the company's largest automobile is in the work of tearing up macadam pavement. This work is often too hard for four horses, but when a plow is attached to the heavy truck by a thick rope or chain, a ditch can be torn up very quickly. Under ordinary conditions the large truck replaces two three-horse trucks. In 1906 this machine consumed about 1 qt. of gasoline per mile, or an estimated consumption of 0.8 qt. per ton mile.

The company keeps its automobiles in a garage on a yearly contract. The machines are ready for the day at 6:45 a. m., and the care includes cleaning, oiling, filling tanks and all ordinary light repairs. The cost of maintenance has been reduced one-half by this contract, for the company's experience in maintaining its own machines was not satisfactory. The first cost is large, and the cost of repairs may seem excessive, but the cost per mile is reasonable. It is very important that the chauffeur should be a good mechanic, and the best make of machine is none too good for central-station service.

Figures were presented of the cost of operating three of the machines in 1906. The light delivery wagon made 5378 miles last year, the cost of gasoline being $142.72. Repairs came to $524.08, making a total operating cost, including the chauffeur's wages, of 12.8 cents per mile. Allowing 5 per cent interest and 20 per cent depreciation, the total cost of the machine per mile was 30.8 cents. The 16-hp machine made 6481 miles, at a total operating cost of 17.8 cents per mile. Repairs were $906.24, and the total expense 37.6 cents per mile. The heavy truck made 7383 miles during the year. Gasoline cost $301.77 and repairs $255.15. The total expense was 29.1 cents per mile. The company concluded that 35.7 cents per mile is the best result obtainable with a pair of good horses, against a fair average of 32.5 cents with the automobiles.

Mr. Barnes, of the Narragansett Electric Light Company, Providence, stated that his company has four electric delivery wagons capable of hauling 1000 to 2000 lbs. Figuring current at 3.5 cents, interest and depreciation at 20 per cent, and not charging in wages for running the machine on account of its being used by regular men who would have to be on hand anyway, the cost of operation per mile comes to about 26 cents. Card index accounts are kept monthly.

Mr. J. W. Cowles stated that the Boston Edison Company has from 20 to 30 automobiles in its garage which are all owned and cared for by the transportation department of the company. These machines are charged to the department using them at so much per week without drivers. The company's heavy trucks are largely electrics of from 3 to 5 tons capacity, and they are used in cable pulling, pole setting and miscellaneous haulage. There is one emergency wagon for the trouble gang, and another equipped to pump out manholes. Horses are out of the question for the territory covered, which extends as far west as South Framingham, and somewhat beyond, 25 miles from Boston.

The second paper was on "High Efficiency Lamps," by Mr. Doane, of the Bryan-Marsh Company. The author predicted that the metallized carbon lamp will replace the ordinary incandescent as fast as the manufacturers can turn out the high-efficiency units. It is cheaper in the end than the old type of lamp, and changes less in candle-power and life on a fluctuating voltage. Thus, with a voltage drop of 2 or 3 per cent, the candle-power of a metallized filament lamp falls off but 70 per cent as much as the old-style incandescent, which means a larger permissible drop in the circuit and a greater load for the same size of wire. There is a better quality of light in the high-efficiency lamp.

The Gem 50 watt lamp can be operated on the lowest voltage at one-sixth less cost to the central station than the 4-watt, 16-cp lamp, and at a proportionally greater economy over the 3.5 and 3.1 watt lamp. The chances are that there will be no great demand for the 40-watt lamp for the reason that the higher-efficiency lamps actually seem to increase the hours of burning among consumers, tending to broaden out the peak of the load curve. Many central stations are passing from 3.5 or 4 watt lamps to 2.5 watt lamps on account of the admirable color values of the improved light. Lamps should be ordered as far as possible on watt ratings.

The tantalum lamp has a shorter life on 25-cycle, alternating current by about 50 per cent that on direct current. On 60-cycle current its life is but 25 per cent of the normal, and on 133-cycle current, but 12.5 per cent of that on direct current. Under most conditions the metallized filament lamp is cheaper, but many store windows are using tantalum lamps because of their better color values. Increased interest has been noticed in the silk and ribbon counters of department stores which have installed tantalum lamps in their show cases. Mr. Doane suggested that it may be that light will some day be sold by its quality, in consideration of these points. At 6.5 cents per kw-hour, the tantalum lamp is cheaper on direct current. As for Gem lamps, for all costs of power between 1.6 cents and 4 cents per kw-hour, the middle-voltage lamp is cheaper, but at and above 4 cents the lowest-voltage Gem lamp is cheaper. The better color value is the possible explanation of the selection of the highest-efficiency lamp by so many plants.

A paper on "Employers' Liability Insurance" was presented by Mr. Linscott, of the Employers' Liability Assurance Corporation, Limited, with special reference to the standpoint of the central station. It was pointed out that this insurance does away with the retention of counsel and a claim department, saves the time of officers and employees and fixes the annual yearly cost of claims. The premium is the only cost to the electric light company. This is based on the wages of all the employees at a rate based on experience with different hazards. Liability insurance is still young, having been started in the United States as recently as 1886. In 1896 all the companies combined in filing a tariff based on their united experiences, and although the agreement was dropped in 1904, the rates to-day are substantially the same.

Electric plants operating up to a potential of 550 volts have an employers' liability rate based on 1½ per cent of the payroll, and a public liability rate based on 5 per cent of the payroll. It is considered that the chance of accidents to the public is in

a large degree proportional to the number of employees. Plants operating at above 550 volts have a rate based on 2½ per cent of the payroll for employers' liability and 5¾ per cent for public liability. Plants running their wires in subways receive a 1½ per cent rate on both classes of liability. On certain specific risks these rates have to be modified somewhat.

Three-quarters of the suits for liability insurance are brought after the policy has expired. It has been found that if the loss ratio exceeds 20 per cent of the premiums, there is no profit to the company insuring. In Massachusetts, Connecticut and New York the laws require that a reserve shall be set aside each year based on the number of accidents in the preceding 18 months and on the number of outstanding suits. The average cost per accident to all liability companies is about $28. The paper was concluded with the reading of a large number of accident cases illustrating the tendency of court decisions to favor the plaintiffs, and it was explained that the uncertainties of accident insurance are far less definite than those of fire underwriting. The cost of liability insurance is necessarily high on account of the ever present differences in conditions.

New business methods and the work of solicitors received a large amount of attention at the meeting. Mr. S. Fred Smith, of Salem, Mass., read 13 letters from presidents of electric lighting companies in which opinions were given of the value of organized new business work. A brief summary of these is as follows:

1. New business organization desirable.

2. Company already has one organized new-business department. Work should be divided in central-station business among manufacturing, delivery, accounts, securing of new customers and retention of old ones. Team play among departments essential.

3. Approve new-business campaigns. We serve 3500 people. Three solicitors do good work the year round.

4. We have large railway load and thinly populated territory for lighting. Superintendent works for new business.

5. No organized department. All employees work together. Collectors help in this work.

6. No organized general scheme can be laid down for different cities as the conditions require separate treatment of each case.

7. We canvass vigorously for gas business, letting power come second and electric light third.

8. It is doubtful if solicitors would pay under our conditions.

9. We have one solicitor, who does good work; the company advertises in the daily press, and has used the Curtis system.

10. Company does small lighting business, but favors having organized department.

11. Salesman is desirable for special work in securing new customers.

12. Customer's interests must be promoted if central station is to prosper in the long run. It is possible to overwork new customers with but temporary profit. High qualities needed in solicitors.

13. Electric light wiring department gets much new business. Our men are in close touch with the public and consumers in this way. An employee clearing up old accounts, explaining changes, etc., also helps new business. The uses of electricity are increasing so fast that there will soon have to be a division of solicitors' work into departments. A different kind of man is needed in figuring on power propositions than on lighting or general work.

Mr. H. Bottomley, of Fall River, read a number of communications from managers in regard to the desirable qualifications of solicitors. Some of these advocated a technical education in engineering, good habits, promptness, system, neat and prosperous personal appearance, industry, absolute honesty, perseverance, etc. The importance of actually helping the customer to do business better by means of central-station service was emphasized, as well as the significance of the first interview. Methods of instructing salesmen were also mentioned briefly.

Storage Batteries Discussed at the Western Society of Engineers.

At the regular meeting of the electrical section of the Western Society of Engineers, held in the Monadnock Block, Chicago, March 15, Mr. J. M. S. Waring, of the Electric Storage Battery Company, presented a paper on "The Application of the Storage Battery for Lighting, Power and Railway Service." Mr. Waring divided battery installations into two classes, those for supplying power to lamps, and those for operating stationary and railway motors.

The first portion of his paper was concerned with the regulation of batteries, and by means of charts he commented on regulating the differential boosters, by the carbon regulator, by constant-current boosters and by hand regulation. In discussing the advantages to be derived from the use of batteries, he said the losses due to the conversion of the current when the battery was used to maintain a consistent load on the generators were almost negligible as compared with the economy resulting. He said the installation of line batteries frequently saved more than the cost of the batteries in feed wire.

In the discussion which followed the reading of the paper, Mr. P. Junkersfeld said that the battery had been very aptly termed "the watch dog of electric service." He said that in connection with lighting systems in large cities it was used largely for emergency service. Although much economy would often be obtained in discharging it at times, usually it was kept charged and used only in emergencies. In reply to an inquiry from Mr. Junkersfeld, Mr. Waring said that the battery had quite a field in industrial locomotive work where there was frequent opportunity to charge the battery. He cited an instance where a locomotive made a run of two minutes and then stopped for two minutes. He said a battery could be used to advantage in this case by arranging for charging it at each stop. With regard to the use of the battery in alternating-current work substantial progress had been made in the last two years. An installation for use in connection with alternating-current apparatus would be made in the new steel plant at Gary, Ind.

Mr. Waring said that in regular work batteries worked up to an efficiency as high as 90 per cent. In further discussion the statement was made that in the most severe railway service the positive plate had a life of about four years, while the negative plate lasted considerably longer. In less severe work plates lasted seven or eight years or longer.

Booster versus end-cells for regulating batteries used on lighting circuits was the subject of the latter part of the discussion. Mr. D. W. Roper, of the Chicago Edison Company, said the question was brought up at the International Electrical Congress at St. Louis as to which method was the best. In American practice end-cells are used almost entirely, while English practice favors the booster. Mr. Junkersfeld said he thought this was partly accounted for by the fact that in America the standard of electric service was higher. The battery is employed here more as a reserve for emergencies than for continuous operation, and the use of a booster introduced a somewhat unreliable element.

With regard to the economy and the first cost of the two methods, Mr. D. W. Roper said some investigations with which he was once concerned showed that the initial cost was higher for the end-cell method largely by reason of the copper used. The booster method introduced the greater losses. As the number of discharges per year of the battery increased, the lesser efficiency of the booster method made the total cost favor the end-cell method, and, in fact, for practically all cases of American practice he considered the end-cell switch method was the cheaper.

At the close of the meeting the announcement was made that at the April meeting of the society Mr. E. B. Ellicott will present a paper discussing the power development on the Chicago Drainage Canal.

High Tension Transmission.

At a meeting of the American Institute of Electrical Engineers, held on March 22, under the auspices of the High Tension Transmission Committee, there were presented two papers designated as "Introductions to Discussions," relating to high tension transmission. A paper by Mr. B. A. Behrend dealt with the practicability of large generators wound for 20,000 volts, while Mr. P. M. Lincoln presented a paper discussing motor generators versus synchronous converters, with special reference to operation on long distance transmission lines.

After outlining the history of the increase in the generator electromotive force from the value of 2200 volts used at Niagara to 11,000 volts, which is the value used in Brooklyn and New York, Mr. Behrend drew attention to the importance of higher voltages for future plants. The difficulties encountered in winding generators for potentials of from 20,000 to 25,000 volts are primarily mechanical. It is desirable, therefore, for the individual coils to consist of as few conductors as possible, and these conductors should be of such size as to enable the making of mechanically and electrically strong coils. The insulation of the coils against the framework is easier to obtain than that against one another. Even at the present state of the art it is possible to obtain the necessary insulation for 22,000 volts, although the expense is considerable. As soon as there arises a demand for large units wound for 22,000 volts the demand will be met by machines carefully designed for these conditions.

The chief gain obtained by winding generators of large capacity directly for the high potential required for distribution consists in the simplicity of the power plant, and, probably, in a slightly reduced first cost. There has been in operation for several months continuously, both day and night under full load, a 150-kw, 25,000-volt generator, the regulation, heating and the efficiency of which have proved very satisfactory. Mr. Behrend expressed the opinion that where individual units of very large capacity are installed in power plants a potential of 20,000 volts is feasible and it is to be recommended for units of 10,000 kw capacity and above; and that where individual units of small capacity are needed for a potential of 20,000 volts, the conditions can be met in most cases even down to capacities of 150 kw.

Mr. Lincoln compared motor generators and synchronous converters from the seven standpoints of reliability, voltage regulation, corrective effect, efficiency, cost, parallel operation and starting. He stated as a personal opinion that the relative number of hours that a 25-cycle synchronous converter, an induction motor generator and a synchronous motor generator would be out of service within a given time, on account of defects inherent in the apparatus, would be as 10, 14 and 17. respectively. In respect to the automatic change in voltage with change in load, the three converter equipments under discussion are equal, but in respect to the ability to adjust the initial voltage the synchronous converter suffers a great handicap. A difference between the converter and the motor generator sets is found in the fact that the delivered e. m. f. of the converter responds only to changes in the incoming voltage, while that of the motor generator responds only to changes in the incoming frequency. Since changes in incoming line voltage will under normal conditions be much greater and sharper than those in the frequency, the converter will probably suffer by comparison in this respect with the motor generator.

It is desirable in any transmission line that the voltage should remain as nearly constant as possible independent of the load variation and that the voltage should be capable of adjustment within limits at the will of the operator at any time. So far as the voltage regulation may be obtained by means of a change in the power factor of the current taken, the synchronous motor has a distinct advantage over the synchronous converter in that the corrective effects is obtainable without involving the direct current voltage In comparing the efficiencies of the different converter equipments, Mr. Lincoln stated that under a 75 per cent load a 500-kw, 25-cycle synchronous converter has an efficiency of 93 per cent; a synchronous motor generator set of the same capacity has an efficiency of 85 per cent, while an induction motor generator has an efficiency of 84 per cent. An approximate estimate shows that the cost of a synchronous motor generator is the same as that of an induction motor generator, while a synchronous converter represents an investment of about 60 per cent of that of either of the other equipments. In regard to the parallel operation the three converting methods may be considered as being on a par. There is not much choice in the starting qualities of the three methods, but what there is would cause them to be arranged in the following order, namely: first, the induction motor generator set; second, the synchronous converter; and third, the synchronous motor generator. The author concludes that there are only a few cases where the motor generator should be used in preference to the synchronous converter.

In the discussion which followed the reading of the papers, Mr. C. E. Skinner contended that in considering the practicability of winding large generators for 20,000 volts, it is not proper to neglect the increased cost of the equipment. Unless the high-voltage generator, together with the switchboard apparatus, etc., is cheaper than the equivalent low-voltage generator with its transformers, such a generator would not be considered for use in a transmission system. In a plant equipped with low-voltage generators it is not necessary to install an extra generator. If only one unit is used with three transformers connected in delta, it will be possible to operate in case one transformer breaks down, the other two transformers remaining V-connected. In a similar plant equipped with high-voltage generators the capacity of the machinery installed would have to be increased by from 50 to 100 per cent. A generating station containing low-voltage machines with step-up transformers is far easier to protect from lightning than a similar station using high-voltage generators. That the lightning problem is a serious one is shown by the fact that a considerable variety of lightning arresters are installed in connection with the 20,000 volt generators used with the Valtelina Railway, and yet on several occasions the generators have been damaged by lightning discharges.

Mr. W. S. Murray agreed with Mr. Skinner in all of his contentions and stated his belief that for the protection of the generating plants against lightning disturbances there is no better device than well designed step-up transformers.

Mr. A. H. Armstrong remarked that the possibility of building 22,000-volt alternators depends entirely upon the shop work. The main trouble resides in the fact that it is difficult to prepare the coils for a 150-kw machine. The demand for alternators to be connected directly to the transmission line will probably not be very great because they are subject to lightning and other troubles. For underground cable work, such as the Interurban and the Metropolitan systems, there is a probability that some demand will exist for them in the future. In regard to the use of motor generators as compared with rotary converters, the problem resolves itself into one of expediency and cost. For railway work where close voltage regulation is not a requirement, the rotary converter will continue to be the machine selected. Where the bulk of the power is used for lighting purposes, however, it is necessary to employ a motor generator set.

Mr. H. G. Scott called attention to the fact that it is the invariable practice in connection with potentials higher than 20,000 volts to use oil-insulated rather than air-insulated transformers. In a generator it is not possible to use oil insulation. Moreover, the generator is at a disadvantage in that in case of accident the whole machine must be out of commission, but in the case of an accident to one transformer in a bank of three it is possible to continue operation with two-thirds of the transformer capacity. The protection afforded the generators by transformers is so great that seldom indeed have generators been destroyed by lightning where transformers were interposed between them and the line.

Mr. Ralph D. Mershon did not agree with Mr. Lincoln as to

the relative reliability of a synchronous converter and the motor-generator sets. Experience has shown that 30-cycle rotary converters have given more trouble than 60-cycle generator sets. He said he had known of several cases where generators connected with the step-up transformers in the line had been damaged by reason of lightning discharges. The appearance subsequent to the damage seemed to indicate that whatever trouble was caused by the arcing in the transformer was removed by the healing action of the oil.

Mr. C. W. Stone, in commenting upon the starting characteristics of synchronous converters and motor generators remarked that he had seen converters as large as 1500-kw brought up from rest on the alternating current side and connected to the line inside of 40 seconds. For 60-cycle work, a converter will cost equally as much if not more than a motor generator set. The fact that the rotary converter is provided with numerous collector rings and brushes on the alternating current side, in addition to the commutator and brushes on the direct current side, renders the attendance for this machine practically as great as that required for a motor generator set.

Mr. Percy H. Thomas reported the results of an examination made on a high tension generator which had been damaged by lightning. The discharge had short-circuited not only the first coil, but all of the others. In jumping across the first the second was damaged; in jumping across the second the third was damaged, etc., and the machine was burned so badly that all of the coils had to be replaced.

Mr. Torchio gave some estimates concerning the relative cost and efficiency of alternators for various voltages as submitted by the manufacturers for a certain 15-mile transmission system where a total power of 40-kw would be generated. The preliminary estimates showed that taking the cost of a 2300-volt alternator as 100, a 15,000-volt machine would cost 130, and a 25,000-volt, 155. The efficiency of the first machine would be 96 per cent; the second 95¼ and the third 94 1-5 per cent. It would seem therefore that as far as the cost and efficiency are concerned there would be hardly any difference between low voltage generators with step-up transformers and 25,000 volt generators.

Mr. C. F. Scott stated that while Mr. Lincoln's paper is excellent in that it gives a general survey of conditions for a given class of service, and has placed the three types of apparatus in a certain order of selection, others have expressed opinion reversing his order of merit. Each person has given conclusions, but has not named the specific points which caused him to draw such conclusions. The simplest kind of apparatus is the direct-current generator on the one end and the induction motor on the other, but there may be persons who claim that induction motor-generator sets give greater causes for complaint than any other types of equipment. In discussing Mr. Behrend's paper on high-voltage generators, Mr. Scott showed that assuming No. 6 to be the smallest convenient size of wire in the transmission line, a 25-mile transmission circuit will cost probably $25,000. It would seem therefore that unless the power is considerably more than 150 kilowatts the cost per kilowatt would be quite high. Seldom indeed would a generator of 150 kw be required for a voltage of 25,000, which would never be justified for a distance of less than 25 miles.

Mr. W. L. Waters stated that by the use of commutating poles a 1500-kw direct-current generator can be built to operate at a speed of 300 r. p. m. When such a machine is used in a motor generator set there is no difference between the cost of the set and a synchronous converter, which for 25 cycles would run at about 187 r. p. m. Speaking generally, from the operating standpoint, a motor generator is preferable to a synchronous converter in almost every respect, except as to efficiency and cost. When comparatively cheap medium sized units are wanted under conditions where close voltage regulation is unimportant, synchronous converters would be used, but when large sized units are desired and when the voltage regulation and general flexibility are important, motor generators would be preferred. In regard to high voltage alternators there will undoubtedly be a certain demand for such generators for large city power systems because 20,000-volt cables are now commercially available. Such alternators in large sizes can be manufactured to operate as readily as the 6000 or 12,000-volt machines at present on the market.

In commenting on his own paper, Mr. Lincoln said that it is usual in operating rotary converters to place in the supply circuits locally a high reactance, which has the effect of allowing only that particular rotary converter to compound without affecting the remainder of the system. Such reactance has the additional advantageous characteristic of limiting the current on short circuit.

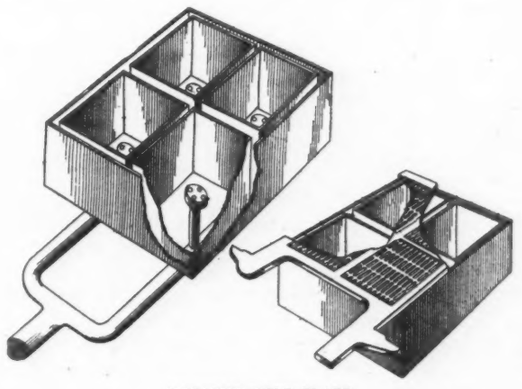
In his closing remarks Mr. Behrend stated that the price of a 200-kw, 22,000-volt, three-phase, 600-r. p. m. generator, with three 75-kw, 2200-volt to 22,000-volt transformers, is $3,849, while the price for one 200-kw, 22,000-volt, three-phase, 600-r. p. m. machine would be $3,837, showing a difference of only $12. The total boxed weight of either equipment complete would be about 31,000 pounds. The conditions which determine the choice of the voltage do not relate to the ability of the manufacturer to furnish certain apparatus, but they refer to factors external to the power plant when considered from the point of view of a good engineer who can see the system in its entirety.

Written contributions were sent in by Messrs. E. J. Berg, Guido Semenza, R. C. Carson, W. R. Jackson, A. C. Pratt, Leo Schuler, B. C. Shipman, O. B. Caldwell, Henry Floy, W. J. Foster, Clarence E. Gifford, Farley Osgood, John C. Parker, H. F. Parshall, John Pearson, Bertrand P. Rowe, Carl Schwartz, Miles Walker, J. B. Whitehead, A. H. Babcock, Edward P. Burch, J. R. C. Armstrong, F. O. Blackwell and R. S. Kelsch.

Negative Pole Plate.

Under date of Feb. 26 Joseph Bijur was granted a patent for improvements in processes of treating negative battery plates and products. The objects of the invention are to prevent the loss of capacity in the plate and coherence of the porous sponge into a metallic mass; ensure permanent passageways for the diffusion of the electrolyte and to secure strong and hardy plates which will not become permanently sulphated.

The active material of the plate is impregnated with inert material, such as carbon, which is not acted upon chemically by



NEGATIVE POLE PLATE.

the electrolyte. The plate is formed and reduced in the usual manner and allowed to dry. It is then soaked in a solution of sugar which penetrates the pores readily. The plate is then removed from the solution and subjected to heat of sufficient intensity to completely carbonize the sugar. If the plate has antimonious alloy parts it is treated in such manner that these parts are heated less than the lead parts so that the former are not partially fused in the treatment. The illustration shows the framework provided with air spaces between the walls and having compartments of substantially the same size as the grills of the plate, so that the framework of the plate lies over the

air spaces. By this means the grills may be subjected to a higher degree of heat than the frame of the plate.

Inactive material may thus be introduced into the pores of Planté plates after they have been formed or after they have been in use. The process may also be carried out with pasted plates, since the negative material may be introduced into the pores of the active mass after they have been in use and have partially lost their capacity from the lack of such material, thereby again raising the capacity of the plate. The invention also contemplates soaking a Planté or pasted plate in a solution, such as sodium silicate, in which case the inactive material is deposited in the pores of the active mass chemically. The plate after having been thus treated has a light brownish-gray color instead of the usual lead-gray color. It also has a porous and spongy appearance, as distinguished from the ordinary Planté plate not thus treated. The capacity of the plate thus treated either remains substantially the same or rises instead of falling off.

Iowa Electrical Association Programme.

The programme of the Iowa Electrical Association, which is to hold its convention at Lafayette Inn, Clinton, Ia., Thursday and Friday, April 18 and 19, 1907, is as follows: Thursday, morning session: Call to order, 10 a. m.; reading of minutes; address of welcome; President's address; reports of the secretary, executive committee, finance committee, programme committee, election of nominating committee, general business; statistics, "Cost of Operation per Dollar of Income," Prof. L. B. Spinney; paper, "Central Station Economies," Mr. Gus Lundgren, Cherokee, Ia. Afternoon session: Paper, "Increasing the Central Station Day Load," Mr. E. S. Callahan, General Electric Company; paper, "Manufacture of Ice," Mr. Rufus Lee, Clarinda, Ia.; paper, "Co-operation," Mr. J. R. Crouse; paper, "Central Station Advertising," The Curtis Advertising Company.

Friday, morning session: Paper, "Central Station Heating" (steam and hot water), Mr. W. H. Schott; paper, "Selection of Steam Engines," Mr. H. E. Chase; paper, "Gas Producer Engines," Prof. G. W. Bissell, Iowa State College; paper, "Electric Distribution Systems," Prof. A. H. Ford, Iowa State University. Afternoon session: Paper, "Nernst Lamps for Street Lighting," Mr. Frank McMasters. Executive session: Informal interchange of ideas; report of treasurer; report of nominating committee; election of officers; adjournment.

Prof. L. B. Spinney, of Ames, Ia., is secretary and Mr. P. P. Crafts is chairman of the local committee of arrangements at Clinton.

Electrical Development in Germany.

The German electrical industry looks back upon 1906 as about the most successful year that it has ever had, and it looks forward to 1907 as full of promise for the continuance of prosperity. The upward trend in the industry is clearly indicated by the fact that the largest electrical companies in the country, representing a capital of $110,000,000, had about 17 per cent more workmen employed at the end of 1906 than at the end of 1905. Smaller concerns are not included in this comparison, and it is said that their working force was increased at a still greater ratio. Dividends declared in the course of last year also show up well when compared with those of 1905, having averaged 8.10 per cent, as against 7.40 per cent. This may be regarded as a most satisfactory result, especially in view of the fact that electrical companies had great difficulty in the earlier part of the year in raising the prices of finished goods in proportion to the cost of raw materials.

The price situation, however, changed for the better in the second half of the year, as the great boom became more pronounced throughout the entire range of German industries; and prices are still being advanced. The manufacturers of motors about the beginning of this month again added 10 per cent to their prices, which makes an increase of not less than 25 per cent since this time last year. This latest advance was explained as caused by the continued rise of copper and brass, as well as other materials. The business in motors was described at the same time as very active.

The immediate future of the electrical industry is regarded as largely dependent upon the continuance of the boom in the iron and coal trades. It was in these that the greatest expansion in the application of electrical power occurred last year. The greatest activity was in rolling mills, since there is much more unoccupied room for electricity with them than with coal mines, the latter having already been much more largely electrified than iron establishments. However, there is still much work to be done in the way of putting in hoisting machinery at collieries. If the present high state of prosperity in the iron trade continues throughout the year, as everything indicates that it will, then the electrical companies will have plenty of work to do and will earn fully as much money this year as they did in 1906. One unfavorable feature of the situation remains for the electrical industry, namely, that raw materials of every description are unusually high in price. Still another troublesome factor is the scarcity of labor. The demand for labor of all kinds in the general industries of the country has far outrun the supply; and in the electrical industry, where much skilled labor is called for, men cannot be found and trained for high-class work as rapidly as they are needed. Owing to the scarcity of labor many of the shops are compelled to run over time, while others are putting on night shifts.

The Prussian Statistical Office has recently published some interesting figures showing the steam power used in Prussia for the generation of electrical energy. These statistics, taken for April 1, 1906, show that there were 4,424 steam engines used wholly in driving motors, which generated an aggregate of 760,027 horsepower. Besides this 123,337 horsepower was generated by engines partly used for other purposes. The increase as compared with the corresponding data of 1905 was 276 engines, while the horsepower generated gained 94,383. Within three years the amount of electrical energy generated by steam increased 260,030 horsepower, or slightly less than 42 per cent. These figures do not include the large volume of electrical energy created by gas engines and by water power development, for which, unfortunately, no statistics are at hand.

The increased use of electricity in Berlin is reflected by the report of the Berlin Electrical Works for the half year ended December 31, showing that 71,698,000 kw-hours were sold, as compared with 61,661,000 for the corresponding period of 1905—the gain being about 16 per cent. Of the amounts here given the street railways took 26,206,000 kw-hours, as against 25,178,000 in 1905.

German electrical companies and banks are interested in the so-called Belgian-Argentine Tramway Trust, which is about to be organized at Brussels to take over and consolidate the street railways of Buenos Ayres. The capital of the trust is to be $13,000,000 for the present, but it will be increased to $16,000,000 within two or three years, besides the issue of $3,000,000 in bonds. A number of Belgian and French banks and electrical companies will own more than two-thirds of the capital, while German interests will hold almost one-third. The Gesellschaft für Elektrische Unternehmungen, which is closely allied with the Allgemeine Electrical Company, will take $2,020,000 of the stock, while other Berlin capitalists will take $1,400,000. The trust hopes by combining the traction companies of Buenos Ayres and eliminating competition to create a first-class earning property. The trackage will be about equal to that of the Great Berlin Street Railway. The new company will take current from the works of the Deutsche-Ueberseeische Elektricitaets-Gesellschaft, of Berlin, which only recently added nearly $9,000,000 to its capital in order to enlarge its generating plant at Buenos Ayres, acquire the

tramways of Montevideo, and of a leading Chilian city.

An order for steam-driven dynamos for the municipal electrical works at Montevideo has just been placed with the Felten & Guilleaume-Lahmeyer Works. The State of Uruguay is at the back of the new organization at Montevideo, which has a monopoly for a certain period in supplying electricity for lighting and power purposes in that city. For the present three steam dynamos each of 3,000 hp will be put in, and others later as required.

A great controversy has been raging for above a year between the Rheinisch-Westfälische Elektricitaets-Werke of Essen and several municipalities in that region, which have been fighting to prevent that company from securing a monopoly in supplying electricity to the towns in the eastern part of that great industrial region. This company is chiefly the creation of Herr Hugo Stinnes, one of the leading coal magnates of Germany, who carved out a wholly unique scope of work for it. The introduction of gas-saving appliances at blast furnaces and coke ovens in that region convinced Stinnes that a great company to act as a sort of power exchange was needed there, since many concerns were generating more power than they needed, while others, not wishing to incur the expense of putting in plants for saving and cleaning gases, would willingly buy electrical energy in large and regular volume, and a number of towns could be supplied with electricity for illumination and traction purposes.

The idea was a sound one. The new company was organized two or three years ago and has had a most successful career. Not only does it buy the surplus power generated by blast furnaces and coke ovens, but it has established at Essen and other parts of the great industrial region big generating plants of its own; and it has found a large and active market for electrical energy, which it has been able to sell at exceptionally low prices.

Its advance has been so rapid that some of the towns in the eastern section of the industrial district took alarm lest the company would grow into a too powerful monopoly. These have been resisting its encroachments upon their territory by plans for municipal electrical works, but the Stinnes Company is pushing forward to completion a great central station in that section. Latterly, however, a compromise seems about to be arranged according to which the municipalities of Hagen, Hoerde, and several country districts around Dortmund shall acquire 80 per cent of the stock of new Stinnes works, leaving him 20 per cent, in lieu of completing their own electrical generating stations. Stinnes had begun to supply the great iron works at Hoerde with energy at 4 to 4½ pfennigs (about 1 cent) per kw-hour.

In the midst of the general prosperity of the German electrical industry it sounds singular to hear that the Nordische Electrical and Steel Works at Dantsic have failed. It was established six or seven years ago, under government encouragement and partly with government money, the authorities adopting this method of starting an industrial development in the eastern provinces. The concern got under way just as the great boom of six or eight years ago was about to collapse and it was hard hit by the failure of the Kummer Company, of Dresden, in 1901. It has never been a paying investment. Its brief and disastrous career is an eloquent proof of the proposition that governments ought to leave the establishment of industrial enterprises to private individuals, who have the money and the business insight to take advantage of all hopeful openings for industry. A manufacturing plant as an eleemosynary institution cannot succeed even in Germany, notwithstanding the large reserves of intelligence and efficiency at the disposal of the government.

Connecticut River Hydro-Electric Development.

A bill passed at the present session of the New Hampshire Legislature finally assures a project for a 12,000-hp hydro-electric development on the Connecticut River at Hinsdale, N. H. The construction of a dam to develop a fall of 26 ft. will shortly be commenced. The barring of the river at Hinsdale will create a lake about eight miles long, extending within two miles of Brattleboro, Vt., and the legislation just secured and similar powers previously obtained from the Vermont Legislature give the right of eminent domain in obtaining title to the lands that will be submerged. The expenditure will exceed $1,000,000 and it is expected to sell current at from $25 to $30 per hp-year. Messrs. Chas. W. Dunham, Chas. A. Harris and Clarke C. Fitts have carried the project to its present stage, and have secured the necessary financial support to carry the work to completion from H. I. Harriman, of Hyde Park, Mass., and M. G. Chace, of Providence, R. I.

CURRENT NEWS AND NOTES.

A CORRECTION.—Through an error the article entitled "Multiplex Telephony" which appeared in our issue of March 16 bore the signature Charles S. Walden, instead of C. E. Fairbanks, the writer of the article.

ELECTROLYSIS.—F. N. Waterman will present a paper on "Electrolysis and Stray Currents" at the next meeting of the Electrical Engineering Society of Columbia University, New York City, to be held at 8:15 p. m., Wednesday, April 3, in Room 301 Engineering Building of the University. All interested are cordially invited to attend.

N. E. L. A. CONVENTION.—Mr. Dudley Farrand, chairman of the Convention Committee, has issued a circular this week as to the Washington meeting, June 4, 5, 6 and 7, with headquarters at the New Willard Hotel, where the exhibit of apparatus will also be made. Mr. G. F. Porter, the Master of Transportation, is now arranging for special rates and trains, and the attendance promises to be very large.

FENCING RIGHT OF WAY.—In the New York Legislature, Assemblyman Parker has presented a measure compelling the Niagara, Lockport & Ontario Power Company to fence in its rights of way to protect people and animals from coming in contact with towers or other charged structures. It is understood that several persons have been killed in this way. The company recently had a bill introduced permitting the Governor to appoint special policemen to protect its property.

RELATIONS WITH THE PUBLIC.—A joint meeting of the Committees on Municipal Ownership and Public Relations of the National Electric Light Association and the American Street and Interurban Railway Association was held in New York March 22, 1907. Representatives of the gas and telephone interests also participated. Among those present were J. B. McCall, C. L. Edgar, Arthur Williams, W. H. Gardner, H. L. Doherty, E. W. Burdett, C. D. Wyman, W. Caryl Ely, H. A. Robinson, B. F. Swenson and Walton Clark. The meeting was devoted to a general discussion of the relations of corporations to the public and to the state, and concluded in the evening with a dinner at the Waldorf-Astoria.

MURRAY TELEGRAPH SYSTEM.—We are informed by the inventor, Mr. Donald Murray, that the trials of the Murray automatic printing telegraph system in Russia have been satisfactory and that the Russian administration has ordered another installation for St. Petersburg-Irkutsk, a distance of about 3800 miles of iron wire with six repeating stations. So far as printing telegraphy is concerned, this is believed to be the world's record, the distance being three times longer than any other line reported operating by a printing telegraph. The Swedish administration has also ordered a complete duplex outfit of the the Murray system for Stockholm-Gotenburg. Two new installations are nearly completed to the order of the German post-office, and the Murray system between Bombay and Calcutta is now being started.

HONORING BELL.—A delegation from Brantford, Ont., has asked the Ottawa Government for $10,000 for the Alexander Graham Bell memorial in that city, which is to cost $40,000. Premier Laurier informed them that he personally was in favor of honoring the inventor of the telephone and would bring the matter before his colleagues.

ANOTHER UTILITIES BILL.—Another public utilities bill embodying the ideas of Attorney General Jackson, who is opposed to the measure of Governor Hughes, has been introduced in the New York Legislature. The bill makes the Attorney General the counsel of the Commissioners who shall have charge of public utilities. There shall be five of them, to be elected by the people. A specific provision that municipalities may construct their own plants if the voters so decide is in the measure. The hand of William R. Hearst is seen in the municipal-ownership provision.

OKLAHOMA CONVENTION.—The recently formed Oklahoma Electric Light, Railway & Gas Association, which will hold its first annual convention April 22 and 23 at Oklahoma City, will have a programme consisting of three papers on electric lighting, three on electric railway work and three on gas. The following are the officers of the new association: President, F. H. Tidman, Oklahoma City; secretary, Charles W. Ford, Oklahoma City; treasurer, J. H. Merrill, South McAllister, I. T.; first vice-president, F. P. Stearns, Shawnee, Okla.; second vice-president, H. G. Stettmund, Chandler, Okla.; third vice-president, E. M. Cooper, Wilburton, I. T. Executive committee: G. Crowe, Guthrie, Okla.; J. C. Fisher, Shawnee, Okla.; C. F. Mercer, Geary, Okla.; H. G. Stettmund, Chandler, Okla. Advisory committee: F. Benton, Lawton, Okla.; R. D. Long, Muskogee, I. T.; W. E. Fertig, Muskogee, I. T.

A LECTURE ON VESUVIUS, of a most interesting character, was delivered by Mr. John W. Lieb, Jr., in the main auditorium of the Engineering Societies Building, New York City, on March 21, before the American Society of Mechanical Engineers. Ladies were invited to attend, and were present in large numbers, the audience comprising no fewer than 1200 persons. Mr. Lieb was at Vesuvius soon after the great eruption last year, and himself secured many admirable photographs. These were supplemented by others, as lantern slides, taken by Mr. Frank A. Perret, of the Vesuvius observatory, and by some wonderful moving pictures of discharges of smoke, ashes, etc., lava flow, exodus of peasants, etc., loaned by Mr. Burton Holmes. Mr. Lieb presented also a great many maps and views of Pompeii and Herculaneum, and described the excavations and their results. It was altogether a most delightful and instructive evening.

IOWA ELECTRICAL ASSOCIATION.—The local committee for arrangements for the convenience of the Iowa Electrical Association, to be held at Clinton, Ia., April 18th and 19th, and the Iowa Street & Interurban Railway Association, to be held at the same place April 19th and 20th, have sent out an announcement to manufacturers and manufacturers' representatives, giving a map of the available exhibition spaces in the Lafayette Inn, which is to be the headquarters hotel during the conventions. The local committee consists of Messrs. P. P. Crafts, R. M. Howard and Thomas Crawford. The exhibit space is in the basement of the hotel. The current furnished will be single-phase, 60-cycle, 110 and 220-volt, alternating and 600-volt direct current. The committee must be advised by April 15th as to space reservations desired. Arrangements have been made with the Western Passenger Association for a rate of one-third fare on the certificate plan to any part of the State of Iowa and from Chicago, St. Louis and Minneapolis.

A. I. E. E. AT PURDUE.—Mr. W. T. Small, instructor in the Electrical Department of Purdue University, presented a most interesting paper before the local branch of the American Institute of Electrical Engineers, Tuesday evening, March 19, on the subject of "The Mercury Arc Rectifier." For some years after graduation, Mr. Small was connected with the Cooper Hewitt Electric Company and had particularly to do with the arc rectifier. He is probably one of the best informed men on that subject. The talk was supplemented by blackboard sketches and examples, by the aid of which the theory and operation of the rectifier were shown according to the present day practice. In addition, Mr. Small had installed a rectifier near the front of the lecture room, and gave practical demonstrations of its method of operation. From the direct-current side, an arc lamp, a fan motor and a small multipolar motor were operated. Besides the arc rectifier, the Cooper Hewitt lamp was discussed, as well as the different methods of connecting the rectifier for use with constant-current transformers for obtaining direct current for street arc lighting.

ELECTRIC SUBURBAN TRAVEL.—The substitution of electricity for steam on railroad occupies increasingly the thoughts of railroad managers. The opinion that a complete surrender of suburban traffic by steam railroads to street railways will be the best solution of the problem of handling traffic between Boston and its suburbs was expressed last week by President Lucius Tuttle, of the Boston & Maine Railroad, in a letter to Charles S. Hoyt, of Winchester. Mr. Tuttle's letter was in reply to a suggestion that the Boston & Maine equip the portion of its line between Boston and Stoneham with electricity. He said that the substitution of electricity for steam power in general railroad service "has not passed beyond the experimental stage." After citing the competition of electric railways, he concludes: "It is upon the whole now becoming a question whether there is any profit at all derivable by the steam railroads from the carrying of short distance suburban travel, at the existing low rates charged therefor; and not only the Boston & Maine, but railroads carrying similar traffic everywhere, are fast coming to the belief that the surrender of this kind of travel to the street railways and interurban trolley lines will be, from every point of view, the best solution of the problem."

WIRELESS ON RAILROADS.—Mr. Nikola Tesla, in a letter to the *New York Times,* says: "No argument is needed to show that the railroads offer opportunities for advantageous uses of a practical wireless system. Without question, its widest field of application is the conveyance to the trains of such general information as is indispensable for keeping the traveler in touch with the world. In the near future a telegraphic printer of news, a stock ticker, a telephone, and other kindred appliances will form part of the regular wireless equipment of a railroad train. Success in this sphere is all the more certain, as the new is not antagonistic but, on the contrary, very helpful to the old. The technical difficulties are minimized by the employment of a transmitter the effectiveness of which is unimpaired by distance. In view of the great losses of life and property improved safety devices on the cars are urgently needed. But upon careful investigation it will be found that the outlook in this direction is not very promising for the wireless art. In the first place the railroads are rapidly changing to electric motive power, and in all such cases the lines become available for the operation of all sorts of signaling apparatus, of which the telephone is by far the most important. This valuable improvement is due to Prof. J. Puley, who introduced it in Germany eight years ago. By enabling the engineer or conductor of any train to call up any other train or station along the track and obtain full and unmistakable information, the liability of collisions and other accidents will be greatly reduced. Public opinion should compel the immediate adoption of this invention. Those roads which do not contemplate this transformation might avail themselves of wireless transmission for similar purposes, but inasmuch as every train will require in addition to a complete outfit an expert operator, many roads may prefer to use a wire, unless a wireless telephone can be offered to them."

TELEPHONY IN OHIO.—The Ohio Independent Telephone Association will hold its convention this week at the Hotel Hartman, Columbus, beginning March 28, when a large attendance is expected from the nine districts into which the State is divided.

TELEPHONY IN SIAM.—The Siamese Minister of Public Works has received the sanction of the King to the proposal to acquire and install an entirely up-to-date telephone system in Bangkok. The system decided on is the central battery system. The installation will go to public tender. The Minister is now engaged arranging for a new cable from Koh-Si-Chang to Sirachi with connection to Bangkok.

SIZE OF THE EARTH.—In a letter to the New York *Times* on his wireless torpedo experiments and trials, Mr. Nikola Tesla says: "As to projecting wave-energy to any particular region of the globe, I have given a clear description of the means in technical publications. Not only can this be done by the use of my devices, but the spot at which the desired effect is to be produced can be calculated very closely, assuming the accepted terrestrial measurements to be correct. This, of course, is not the case. Up to this day we do not know a diameter of the globe within 1000 ft. My wireless plant will enable me to determine it within 50 ft. or less, when it will be possible to rectify many geodetical data and make such calculations as those referred to with greater accuracy."

LOW ELECTRIC FIRE RISK IN CHICAGO.—Figures recently given out by William Carroll, head of the Department of Electricity of the city of Chicago, show that in 1906 only 43 out of 6387 fires were caused by electricity, and the loss from electrical fires was only $300. Chicago has had one of the most rigid systems of city electrical inspection in vogue anywhere in the country and the results are shown in the very small electrical fire loss. All fires in buildings where electric wiring exists are investigated by the department at once to determine if the cause could possibly be due to defective electric wiring. There has been a notable decrease for the past four years in the number of fires caused by electricity, which goes to show that modern wiring rules and inspection are able to reduce the electric fire hazard in spite of the fact that the number of wired buildings is constantly on the increase.

GRAFTING IN SAN FRANCISCO.—Under the rule of the labor unions and their bosses, the city of San Francisco has descended to about the lowest depth that a great city can reach in "grafting." The helpless corporations have been bled unmercifully, and the facts are now coming out. In order to get powers to run again, etc., after the great disaster, it is alleged that the United Railroads Company paid each supervisor $40,000 and to Schmitz and Ruef, the municipal bosses, $400,000. The Pacific States Telephone Company paid to ten supervisors $5,000 each, it is alleged, to prevent the granting of an ordinance to the Home Company. The Home Telephone Company is also alleged to have paid to seven supervisors $6,000 each, and to Ruef and Schmitz (estimated) $150,000 to secure its ordinance. The San Francisco Gas & Electric Company is stated to have paid the ten supervisors $750 each. All payments were made in currency. A large number of indictments are now being returned against all the city officials incriminated and various officials of the private corporations.

SYRACUSE LIGHTING RATES.—The Syracuse (N. Y.) Lighting Company has abandoned its fight against the reduction in gas and electricity rates ordered by the State Commission of Gas and Electricity. President John J. Cummins, for the company and for its associate corporation, the Syracuse Gas Company, has issued an announcement that the commission's order would be fully complied with and that all litigation over it was ended. The order was to have been effective Oct. 1 last. Because of the company's appeal to the Appellate Division of the Supreme Court consumers have been obliged to pay the old rates. Mr. Cummins announced that on presentation of receipts at the company's office consumers would at once be paid a rebate of the excess charges with 6 per cent interest. The order of the State fixes 95 cents per thousand cubic feet as the maximum price for gas, 9 cents per kilowatt hour for electricity until Oct. 1, 1907, and 8 cents per kw-hour thereafter, and $68 per street arc lamp per year. It also fixes a standard of service for gas, requires an improved system for the inspection of arc lamps and establishes a classified schedule of rates for electric energy for lamps, heaters and motors. The arc lamps used consume 450 watts, and are run on an all-night schedule.

BRITISH PATENT LAW.—On March 19, Mr. Lloyd-George, president of the Board of Trade, introduced a bill amending the existing patent laws in the House of Commons. Mr. Lloyd-George explained that the adoption of his bill would simplify and cheapen the procedure regarding patents, but that its main object was to prevent the patent laws from being used for the hindrance and suppression of British industrial development. He said that out of 14,700 patents issued last year, 6,500 were to foreigners. He did not object to that, but a good many patents were taken out for the purpose of preventing the working of patents in this country. The present bill proposes that any applicant shall be permitted to demand the revocation of a patent at the expiration of three years if it has not been adequately worked in the United Kingdom. Mr. Lloyd-George added that, although his measure was in the interests of free trade, he was not afraid of foreign competition so long as British trade was free to fight it. Many British industries were now bound hand and foot by the working of the present patent system, while others had been completely wiped out thereby. His bill was designed to cut these bonds, and set industry free to engage in the severe struggle with which it is confronted. The speech of the president of the Board of Trade was well received on both sides of the house.

NEW YORK TRAVEL.—A special committee report of the Retail Dry Goods Association, which is naturally very much interested in the subject, holds that the city of New York by itself is incapable of working out the local transit problem, and that therefore the municipality and the traction interests should work in harmony. The association will appoint a special committee to confer with all interests, in an effort to obtain relief for the citizens of the city. The committee report is of great length and deals with the subject exhaustively under three heads—the enormous yearly increase in travel, the present financial position of the city and the possibility of municipal construction, and the attitude of the traction interests as bearing on the feasibility of private construction. After statistical discussion, the committee then finds that the municipality is so beset with limitations that it cannot work out the problem alone and that capital stands still while the increase in travel goes ceaselessly on. The report says: "It may be that the municipality on the one side and what may be called traction capital and experience on the other, if they united in a common purpose, eliminated the friction habitually arising between them, and adjusted their respective interests, could bring about some solution of this vexing problem." It is then stated that the purpose of the report is not to commit the association to any policy, but to call attention to the conditions. The report concludes: "As a definite programme we recommend that the association appoint a committee from its members, whose duty it shall be to take up this problem and confer with all authorities, State and municipal, with all interests represented in the transportation systems of New York, and with all other local organizations and civic bodies, and with full power to discuss and negotiatte, formulate, and report any plan or plans looking to that relief of which the whole people of the city stand so sorely in need."

N. E. L. A. QUESTION BOX.—The National Electric Light Association has issued in advance its batch of queries for the Question Box, of which Mr. Paul Lupke, 222 East State Street, Trenton, N. J., is editor. We trust that all our readers who are interested will co-operate to make this useful institution once more a success this year.

ELECTRIC HEATING.—In 1906, no fewer than 737 separate pieces of electric heating and cooking apparatus were connected to the mains of the New York Edison system, equivalent to 9280 lamps of 16-cp. This does not include any that were bought by existing customers for electrical energy and installed without specific rating. That number would probably double the total.

NATIONAL ELECTRIC LIGHT CONVENTION.—The thirtieth annual convention of the National Electric Light Association will be held in Washington, D. C., on the days of Tuesday, Wednesday, Thursday and Friday, June 4, 5, 6 and 7, 1907. The headquarters will be in the New Willard Hotel —the entire tenth floor of which will be devoted to the exhibits of the associate members and the general meetings of the convention.

A BLIND TELEPHONE GIRL.—It is stated that Miss Susie Davis, a girl of 20, is the most accurate and rapid telephone operator in the Virginia City telephone exchange. She has been blind from infancy. When she first applied for the place she was told that it would be impossible for her to manage the switchboard without seeing it, as no other blind person had ever been employed in the telephone service. She persisted and finally got a trial. She learned every number on her board so well that in a recent competition in Virginia City to determine the most efficient operator she beat all competitors. She is a graduate of the School for the Blind at Berkeley, Calif.

CARNEGIE, THE TELEGRAPHER.—The United States Military Telegraph Corps will hold a special reunion and dinner at the Hotel Manhattan on March 28. Mr. Andrew Carnegie, the father of the corps and an honorary member, will be the principal guest of honor. Other guests will be Gen. Thomas T. Eckert and Col. R. C. Clowry, commanders of the corps, and William R. Plum, its historian, past president. It was at Mr. Carnegie's suggestion at the outbreak of the civil war that four operators, D. H. Bates, Richard O'Brien, S. M. Brown and David Strouse, were sent from the Pennsylvania lines to Washington. The subsequent brilliant and patriotic work of the corps is matter of history.

POOLROOMS IN OHIO.—Attorney-General Ellis, of Ohio, has announced that he regards the furnishing of a news service to poolrooms, on the part of any telegraph or telephone company as a violation of its charter, and that upon trustworthy evidence furnished to him that any such news or information service company is supplying a poolroom with such information for such gambling operations he will institute proceedings in the name of the State to oust it from its charter. The announcement was made in the hearing of the complaint filed some time ago against the Western Union Telegraph Company, the American Bell Telephone Company and the Interstate News Bureau.

POWER IN CANADA.—It is announced that engineers representing the Ottawa Hydro-Electric Power Commission have begun a tour to the various municipalities of the province which have expressed by the passage of a by-law their desire to enter into a contract for a supply of electric energy. They will obtain definite information as to the amounts of electrical energy each town will purchase for the use of its power consumers. The amounts mentioned will not be binding on the municipalities but they will be filled in in the blanks in the contracts which have been prepared. It is expected that the whole power scheme will be ready for inauguration in four or five months. When the amounts are known, the commission will then proceed to secure the supply.

THE LONGUE SAULT RAPIDS.—If reports from Canada are trustworthy, the Longue Sault Rapids are to be harnessed in the near future in a manner that will rival, and perhaps beat, Niagara. The recent change in the control of the Canadian St. Lawrence Company foreshadows a great development of electrical power at Speik's Island. There are great possibilities for this plant. On the American side, however, projects are going ahead more rapidly. It is said that representatives of American capital in close touch with the Pittsburg Reduction Company have made a first payment on the whole of Barnhart's Island and a portion of Longue Sault Island and are looking at the property at the foot of Speik's Island. Rumor credits the company with the intention of daming the channel of the South Sault and possibly a part of the Main Sault River as well.

ERIE RAILROAD TROLLEYS.—It is said that the proposed new public utilities bill in New York State is stopping work on trolley spurs and branches of the Erie Railroad. Section 42 of the Public Utilities bill provides that no railroad corporation shall own more than 10 per cent of the capital stock of any other railroad corporation. Were this to become a law the Erie would be barred from acquiring the rest of the stock of these subsidiary companies, and the road after putting its money into these enterprises would not be in a position to control them. On this point E. H. Harriman, a member of the Erie executive committee, said: "As trustees we did not feel that we could assume the responsibility of spending the stockholders' money upon property which we might not be able to hold legally." It is said that as one result, operations on the construction of the Elmira, Waverly & Corning trolley line have been suspended.

THOSE COSTLY FIXTURES.—At the hearing at Harrisburg, Pa., last week, according to the testimony of a witness before the investigating commission which is inquiring into charges of extravagance in the expenditure of $9,000,000 for furnishing the Capitol, the electric fixtures in the new building are lacquered instead of being of solid gold mercurial finish, as required by the specifications. This testimony was given by John Maene, of Philadelphia, who designed many of the fixtures for the Pennsylvania Bronze Company, sub-contractor for John H. Sanderson & Co., contractors for the Capitol furnishings and fittings. He said that a gold finish would cost 20 times as much as the lacquer finish. It was alleged at the hearing also that although not in the Capitol furnishing schedule, and the Board of Public Grounds and Buildings did not advertise for bids for "models" for electric fixtures, Sanderson received $137,500 for "models, sketches and working models for electrical fixtures."

MR. BRYCE'S DISLIKE OF TELEPHONES.—According to a Washington paper, Mr. James Bryce, the new British Ambassador to the United States, has a horror of telephones. The diplomat has frequently been called on the wire since his arrival in Washington, and it is said that on numerous occasions he has refused to talk by means of the speaking piece. When he does talk, however, he insists on knowing immediately who the person is at the other end of the line and his business. Mr. Bryce simply doesn't like this modern method of carrying on a conversation, and as a result gets out of it whenever he can. Long-distance calls are said to be particularly distasteful to the Ambassador. While at times he has consented to talk to people over the telephone in Washington he hates to converse on the long-distance lines. Consequently out-of-town calls for England's new representative are not cordially received, if at all. It may be that Mr. Bryce's dislike of the telephone is due to his experience with the service in Europe under government auspices.

A Small Central Station in Nebraska.

By JAS. A. WARD.

THE village of Crawford, a place of about 1000 inhabitants, is situated in Dawes County, in northwestern Nebraska, on the main line of the Chicago, Burlington & Quincy Railroad and the former Elkhorn branch (now the main line) of the Chicago & Northwestern Railroad. On May 1, 1906, the village Council granted to S. A. Oliver a franchise for the establishment of an electric light plant, and on Feb. 1, 1907, the chairman of the Council turned on the electric current.

The establishment of the plant was brought about by the demand for electric lighting in the village and eventually the lighting of Fort Robinson, situated on the Chicago & Northwestern Railroad, three miles from Crawford. The plant is owned by S. A. Oliver, formerly interested in electric light and power industries in the Black Hills.

The site of the plant was selected with reference to obtaining coal from the Chicago, Burlington & Quincy Railroad, and at the same time to the center of distribution. The power house is located 10 ft. below the level of the main line of the railroad, and the siding which terminates in a trestle 40 ft. long in the rear of the main building forms a coal bin of 100 tons capacity, the bottom of the bin being covered with steel plates, having an incline of 35 degrees to the level of the boiler-room floor.

The building is 40 ft. x 50 ft. in cross section, and is built of hollow concrete blocks. The engine room measures 24 ft. x 40 ft., and is separated from the boiler room by a concrete block division wall. The boiler room section is 24 ft. x 40 ft., and has two rooms at one end; one 10 ft. x 17 ft., used for a stock room, and one 10 ft. x 6 ft. used for lavatory and bathroom. The stock room and bath room are on a level with the engine room floor, with two doors, one leading to the engine room and the other to the boiler room. The boiler room floor is 5 ft. lower than the engine room floor, so as to accommodate the boilers without increasing the height of the building. The floor is concrete, graded to a 2½-in. floor drain at one end of the boiler room, admitting of a free application of the hose and

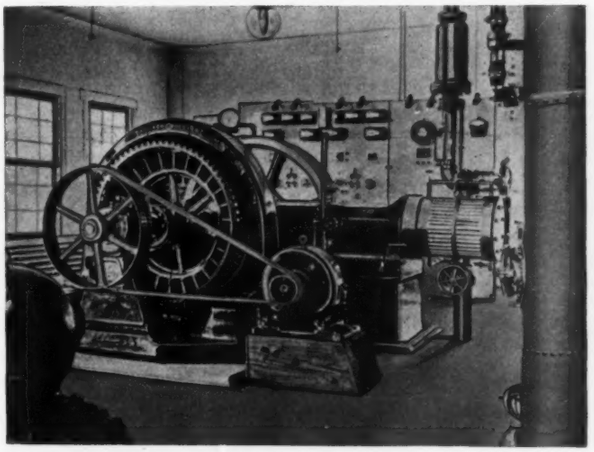


FIG. 1.—60-KW UNIT, CRAWFORD STATION.

insuring a clean floor at all times. Over the engine room is a stock room 20 ft. x 30 ft., reached by stairs from the boiler room.

The boiler room equipment consists of two Kenney internally-fired vertical, water-tube boilers, rated at 150 hp at a steam pressure of 150 lbs. The boilers were built by James G. Heggie, of Joliet, Ill., and the detail of construction is shown herewith. The boilers, which are 68 ins. in diameter and 24 ft. over all, are constructed of 7/16-in. plates, the upper head and crown sheet being ½ in. thick, and dished as shown. The vertical seams are of the double-butt strapped and triple riveted type. The girth seams are of the ordinary lap-joint type. The tube chamber is 60 ins. in diameter and 11 ft. long, and the plates are ⅜-in. thick, and both girth and vertical seams are single riveted. There is a ½-in. tube sheet riveted to each end, which receives 120, 3-in. American lap-welded boiler tubes. There are four round openings 14½ ins. in diameter between the chamber and outer shell. The shell of tube chamber is securely stayed to the outer shell with 1-in. stay bolts, which are spaced 5½ ins. on center. The fire box is 60 ins. in diameter and 36 ins. high, fitted with the Kenney shaking grates; the fire box being connected to the tube chamber by a flanged opening 23 ins. in diameter and 12 ins. long.

The smoke jacket surrounding the boiler proper is 98 ins. in diameter and 20 ft. long, being supported by five brackets bolted to the boiler shell. This jacket is connected through a

FIG. 2.—SWITCHBOARD AND REGULATOR FOR ARC LAMP CIRCUITS.

nipple 28 ins. in diameter and 30 ins. long, in which is installed a damper, directly to a 40-in. uptake, which in turn connects to a 96-ft. steel guyed stack 42 ins. in diameter. The first 40 ft. of this stack is made of 3/16 in. blue annealed steel and the remaining 56 ft. of 3/32-in. plates. The boilers rest on a concrete foundation 18 ft. long and 8 ft. wide by 3 ft. deep, and the stack is erected on a concrete foundation 8 ft. x 8 ft. and 2 ft. deep. After the stack was in place it was filled to a height of 2 ft., inside and out, with a rich mixture of concrete. The stack is fitted with a painter's trolley and two guy bands, the first at a distance of 45 ft. from the ground and the second one at 76 ft. The guys are carried over 25-ft. guy stubs and fastened to ¾-in. guy rods bolted to "dead-men" buried in the ground to a depth of 7 ft.

The method of securing complete combustion in the boiler furnace is as follows: From the fire-box the hot gases pass through the flanged opening in the top of fire-box into the tube chamber, striking a deflecting plate in center of the chamber. After enveloping the boiler tubes in their passage, the gases pass through the four holes connecting the tube chamber with the outside shell into the smoke jacket, and thence downward, enveloping the boiler shell, and out through connections described before, to the stack.

Fig. 7 shows the arrangement of feed-water heater, pump and injector. The first is the Kenney heater and purifier, manutured by Vincent Kenney, of Omaha, Neb. It is of the open type of 300-hp capacity, and rests on a concrete foundation. In the 2½-in. supply pipe from heater to pump is installed a dial thermometer graduated from 50 to 250 degrees for registering the temperature of the feed water, there being also provided in this pipe a gravity feeder with an improved sight feed, supplying boiler compound continuously to boilers. The pump is a 7 x 4 x 8 Marsh, manufactured by the American Steam Pump Company, of Battle Creek, Mich., and is mounted on a cast-iron stand bolted to the floor; the injector used is of the Metropolitan double-tube automatic type, manufactured by the Hayden & Derby Manufacturing Company, of New York, N. Y. Both the pump and injector feed into the 2½-in. feed line which is carried to a point between the boilers where it divides, and two pipe lines

controlled by Crane navy valves pass to the top of boilers inside the smoke jacket, which greatly assists in keeping the water from cooling in its passage to the boilers. At a point near the top of the boiler where the feed-water pipe enters is installed a vertical check valve; there is also a horizontal check valve installed in the main line near where it leaves the pump.

From the bottom of each boiler a 2-in. blow-off pipe leads to the sewer line. In each blow-off pipe is installed a Crane blow-off valve and also a straight way blow-off valve. From each boiler a 5-in. full-weight steam pipe leads from a 5-in. Crane angle valve directly over supply opening in boiler to a 5-in. x 5-in. x 7-in. extra heavy flanged tee. From this tee a 7-in. header extends into the stock room over the engine room, which header is supported by adjustable pipe supports, and carries a 7-in. x 7-in. x 3-in. extra heavy flanged tee, from which is tapped a 3-in. line, which supplies steam for the pump, injector and whistle. Connected to this line through a 3-in. Davis reducing valve is a 3-in. pipe line for heating the station and also the residences of Mr. S. A. Oliver and Supt. J. A. Ward. The header also carries a 7-in. x 7-in. x 4-in. extra heavy flanged tee, from which a 4-in. steam line supplies the smaller generating unit; a 7-in. x 7-in. x 5-in. extra heavy flanged tee supplying the larger unit. In each supply pipe to the engines, near where it leaves the header, is installed a Crane straight-way valve. The main header is drained by a 1-in. drain pipe through a Dunham steam trap. Each boiler is provided with a 3-in. pop safety valve, which is located as near the boilers as possible, and the discharge from the same is piped to the outside of building.

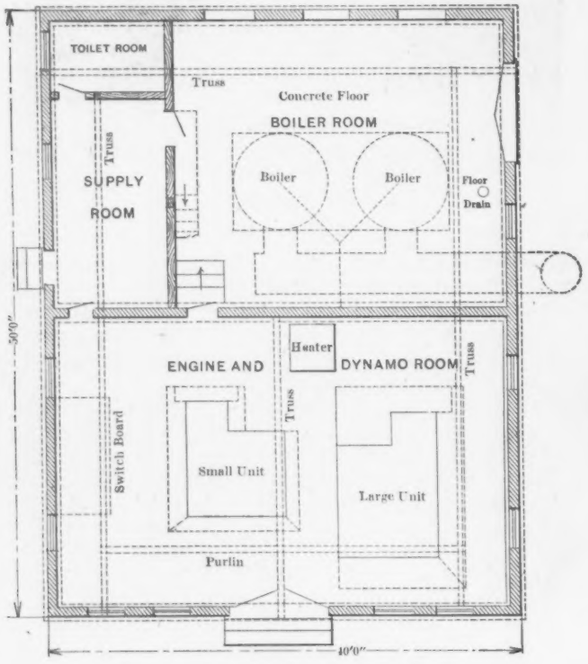


FIG. 3.—PLAN OF CRAWFORD STATION.

The generator equipment consists of one 12-in. x 15-in. Skinner automatic engine, running at 277 r. p. m., direct-connected to a 60-kw, three-phase, 60-cycle, 2300-volt revolving field type alternator, manufactured by the Crocker-Wheeler Company, and one 15-in. x 16-in. Skinner engine running at 257 r. p. m. direct connected to a 120-kw Crocker-Wheeler alternator of similar design. The exciters for both units are of Crocker-Wheeler make are belted to the engine shaft. Fig. 8 is a view of a portion of both units, and Fig. 1 shows the 60-kw unit. Both units rest on a concrete foundation, the holding down bolts running to a depth of 5½ ft. Both engines are provided with the Skinner system of automatic lubrication, the oil being forced to an elevated supply tank by a pump actuated from the cross-head, and from there the oil flows by gravity to the sight feed glasses placed in the guides, and is thus conveyed, by means of oil chambers, to the guides, cross-head pin, main journals, and thence by means of oil chambers drilled through the shaft it is thrown by centrifugal force to the crank pin. The oil after passing through the respective bearings is drained from the engine base into the filter and purifier, where it is freed from all abrasive and foreign substances, and then overflows into the pure oil tank located by the side of the filter, from which it is again pumped into the elevated supply tank. The supply tank, pump and sight feeds are shown on the engine in Fig. 8. The out-board pedestal is provided with an oil cellar and rings which convey the oil to the bearing.

Placed in the steam supply to each engine, directly above the throttle valve, is a vertical steam separator, manufactured by the Steam Appliance Company, of Milwaukee, Wis. Each separator is drained through a Dunham steam trap.

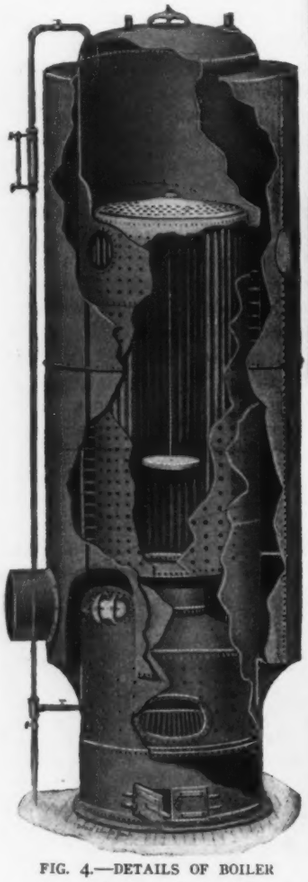


FIG. 4.—DETAILS OF BOILER CONSTRUCTION.

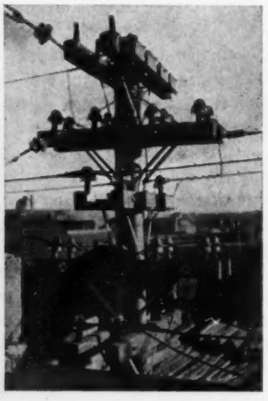


FIG. 5.—JUNCTION POLE.

FIG. 6.—METHOD OF HANGING TRANSFORMERS.

Directly under the cylinder in the exhaust line of each engine is placed a Crane gate valve. From here the lines are carried under the floor to a point opposite the heater, where they enter an 8-in. x 6-in. x 5-in. Y, flanged to an 8-in. Steam Appliance Company's oil separator, which in turn connects to the bottom of the feed water heater, the oil separator being drained independently of the other drains. From the top of the feed-water heater an 8-in. exhaust line leads to a height of 2 ft. above the roof where it is capped by an 8-in. Standard exhaust head manufactured by the Burt Manufacturing Company, of Akron, Ohio. This exhaust head is drained to the sewer by a 1¼-in pipe.

As shown in Fig. 2, the switchboard consists of four panels of blue Vermont marble; two generator panels, one two-circuit feeder panel and one 25 series arc light panel, the main slabs being 62 ins. and the sub-base 28 ins. high. The marble is supported upon standard pipe and angle iron frame work, with the necessary wall stays and fittings. The 120-kw and 60-kw, three-

phase, 60-cycle, 2300-volt generator panels are fitted with three Thomson horizontal edgewise alternating-current ammeters, with series transformers, one Thomson horizontal edgewise field ammeter with shunt; one horizontal edgewise alternating-current voltmeter; two potential transformers; one four-point plug and four receptacles for synchronizer; one double-pole, single-throw field switch with discharge resistance; and three-pole double-throw slide oil switch, and mountings for back-of-board type generator, and exciter field rheosats.

The circuit panel designed for the control of two three-phase 60-cycle, 2300-volt circuits, each of sufficient capacity to handle a maximum of 90 kw, is fitted with two three-pole, double-throw, automatic slide oil switches, equipped with current transformers and tripping coils; one three-phase static ground detector; with six-point plug switch and nine receptacles for throwing ground detector on two of the three phases. The arc panel for the control of one 25-lamp series arc circuit carries one Thomson arc ammeter and one double-pole, double-throw automatic oil switch with series transformers and tripping coils. On the side of generator panel, mounted on a swinging bracket, is a General Electric dial synchronizer and two lamps, for accurately synchronizing the generators for parallel operation.

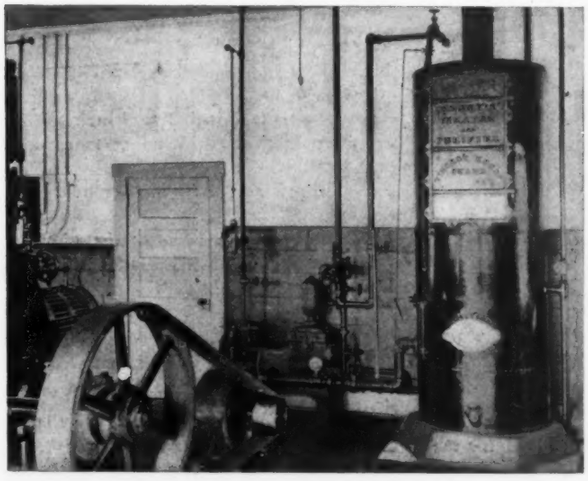


FIG. 7.—PUMP, INJECTOR AND FEED WATER HEATER.

Located by the side of the arc panel is a 25-lamp constant-current reactance regulator, which will maintain a constant current for any number of arc lamps from and including a short circuit to full load. The board is wired with two sets of bus-bars, so the generators can be operated on either circuit separately or in parallel.

From the generators, high tension wires are carried in electro-galvanized conduit under the engine room floor to the switchboard. From the circuit-panel terminals, the circuit wires are carried to the lightning-arrester board placed in the stock room over the engine room. On this board are installed two kicking coils and two Wurts lightning arresters in each circuit wire. The arresters are grounded through a No. 4 rubber-covered wire leading directly to a copper plate 10 ft. square and ⅛ in. thick, buried in charcoal under the engine room at a depth of 16 ft., where water was found. The wires lead from this board to the junction pole outside the building. On this pole the commercial and arc circuits divide and are carried to different parts of the village.

The pole line consists of about three miles of Idaho cedar poles 30 ft. and 35 ft. in length, with 6-in. to 8-in. tops. The line was first surveyed, and every hole staked and numbered, and the depth of hole to be dug marked on stake so as to grade the line. All the poles were framed and numbered in the yards, and each pole erected in the hole of the corresponding number as located in the survey. While this method of designing and plotting the line and framing the poles in the yards required some extra preliminary work, it was more than offset by the time saved in erection.

All cross-arms were painted with one coat of paint before being placed and all pins were dipped. Each cross-arm is fastened by a ½-in. through bolt and braced with two 26-in. galvanized iron braces. All junction and transformer poles are stepped, the steps being placed 36 ins. apart on a side. All poles at angles in the line are guyed with ⅜-in. and ½-in. galvanized stranded guy wire, turn-buckles with "Dirigo" insulators being used in each guy. The guy wires are all anchored to "Stombaugh" guy anchors, the 6-in. and 8-in. type being used.

There are a total of 48 "Wurts" lightning arresters on the line. The arresters are connected by a No. 4 copper wire to a 1¼-in. galvanized iron pipe driven 12 ft. into the ground. Charcoal was placed around the pipe for a depth of 2 ft. below the surface of the ground and 2 ft. in diameter. Fig. 5 shows a junction pole at the center of distribution, carrying primary and secondary wires, guy lines and a bank of 6 lightning arresters. All line wires are the O. K. brand, made by the Phillips Insulated Wire Company. No. 1, B. & S. copper is carried for the lighting circuit to the center of distribution, and Nos. 4, 6 and 8 is used for further distribution. The primary wires are all carried on 10,000-volt triple petticoat Hemingray glass insulators, and the secondary lines on the standard double petticoat insulators.

Installed on the line is a total of 13 transformers of the Stanley G. I. type B. O., 2300 to 220 and 110 volts. These transformers range in size from 1 to 10 kws. Fig. 6 shows the method used in hanging the larger type. The primary wires are carried from the top cross-arm to the transformer through electro-galvanized conduit, thoroughly sealed at each end of the conduit. Porcelain cut-outs are inserted in the circuit at the top and bottom of the pipe.

All transformers feed a three-wire system of secondary distribution, with a voltage of 110 between the neutral and outside wires, the smallest wire used being No. 6 B. & S. gauge. The series alternating arc lamp circuit is 9000 ft. long, No. 6 B. & S. gauge wire being used.

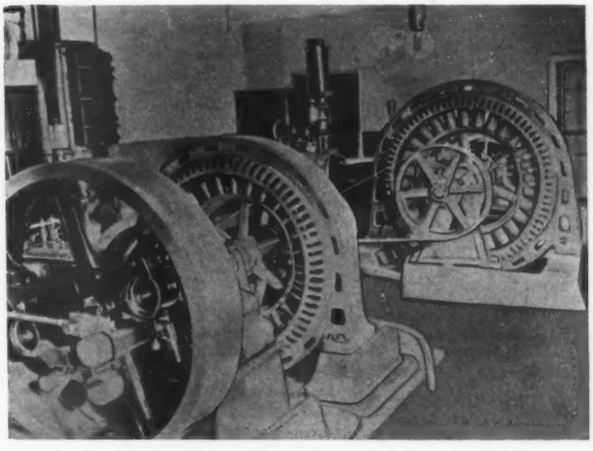


FIG. 8—GENERAL VIEW OF DYNAMO ROOM.

The arc lamps are the Stanley G. I. type K, 6½ ampere, series enclosed arc. They are hung in the center of the streets from ⅜-in. span cables. All arc lamps are hung from Cutter cut-out arc lamp hangers and operated by Ayer's self-locking windlasses, Sampson spot cord being used for suspension.

In all cases where customers use more than five lamps, meters are installed, a deposit of $5 being required, which is returned when the service is discontinued. All the meters used are of Westinghouse type C make. Each meter is mounted on a neat board, which also carries an enclosed fused service switch, all meters being placed not over 6 ft. from the floor, and in as light and convenient a place as possible to admit of easy access in reading and inspection.

The plant was designed by and installed under the supervision of its present superintendent, J. A. Ward, and was constructed entirely by day labor.

Calculation of the Leakage-Reactance of Induction Motors.

By I. E. Hanssen.

Having had occasion to make numerous induction motor calculations, the writer discovered the need of a method for accurately predetermining the leakage reactance of such machines. In looking through the literature on this subject Prof. Adams' excellent papers* naturally presented themselves. It is with no pretence to originality, but with the object of presenting in a condensed form which has in practice been found to combine accuracy with convenience, the several formulæ contained in Prof. Adams' papers that this article is written.

In the case of machines having squirrel-cage rotors an expression for the belt-leakage has been added, as has also a pitch-coefficient "k." The calculation may appear somewhat lengthy, but with a little experience the complete predetermination can easily be done in about 20 minutes; after the slot constants have once been calculated, the rest can be done in from five to six minutes.

As shown in the papers above referred to, the leakage reactance of an induction motor consists of four elements, namely, slot-leakage, zig-zag (tooth tip) leakage, end-connection leakage and belt-leakage.

The nature of these four elements will only be lightly touched upon here, while for an exhaustive treatment of the same the reader must be referred to Prof. Adams' papers. In the following all dimensions are expressed in inches.

In every case the leakage reactance per phase winding may be expressed in ohms as

$$X = 2\pi f L\, 10^{-8} = 1.257 \times 2\pi \times 2.54 \times f \times P \times n^2 = 20 f P n^2 10^{-8} \qquad (1)$$

where

f = frequency
L = inductance
P = effective permeance, in inch measure.
n = number of turns per phase winding.

In order to determine the values of the different leakage elements, it is then necessary to calculate their respective effective permeance.

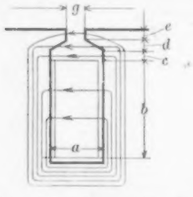


FIG. 1.—SLOT LEAKAGE.

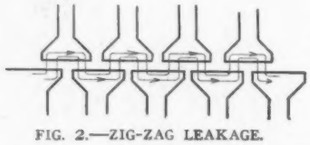


FIG. 2.—ZIG-ZAG LEAKAGE.

SLOT LEAKAGE.

Referring to Fig. 1, the effective permeance for unit length is given by the well known expression:

$$\text{Slot constant} = \frac{b}{3a} + \frac{c}{a} + \frac{2h}{ag} + \frac{e}{g}$$

In the case of a round slot:

$$\text{Slot constant} = .6 + \frac{e}{g}$$

Let:

k_0 = primary slot constant
k_1 = secondary slot constant
C_0 = primary series conductors per slot = $\dfrac{\text{Conductors per slot}}{\text{Circuit per phase}}$
C_1 = secondary series conductors per slot
S_0 = number of primary slots per phase
S_1 = number of secondary slots per phase
p_0 = number of primary phases
p_1 = number of secondary phases
l = axial length of iron.

*Vol. 1. Transactions of the International Electrical Congress, St. Louis, 1904, and
Vol. XXIV. Transactions of the A. I. E. E.

then the primary slot leakage reactance per phase is:

$$X_{0s} = 20 f C_0^2 S_0 l k_0 10^{-8}, \text{ in ohms}$$

the secondary:

$$X_{1s} = 20 f C_1^2 S_1 l k_1 10^{-8}, \text{ in ohms.}$$

which reduced to primary terms is

$$X_{1s} = 20 f C_0^2 \frac{S_0 p_0}{S_1 p_1} l k_1 10^{-8}$$

the total slot reactance is then:

$$X_s = 20 f C_0^2 S_0 l \left(k_0 + \frac{k_1 p_0 S_0}{p_1 S_1} \right) 10^{-8} \text{ in ohms} \qquad (2)$$

For a motor having a squirrel-cage rotor the number of the secondary phases is considered as being equal to that of the primary.

ZIG-ZAG LEAKAGE.

The flux path of this element is indicated in Fig. 2. Let:

Q = average tooth pitch in inches
t_{01} = width of primary tooth face including fringing
t_{11} = width of secondary tooth face including fringing
d = air-gap in inches
fringing = $2\,df_0$ for primary, $2\,df_1$ for secondary (see Fig. 4 for values of f_0 and f_1).

then, as shown by Prof. Adams, the permeance of the path from one primary tooth in series to the opposing secondary tooth and back to the next primary tooth is:

$$\frac{1.7\,Q \left(\dfrac{t_{01}\, t_{11}}{2Q} - \dfrac{1}{2} \right)^2}{d}$$

Designating the square of the term in brackets as k_2, there is obtained for the total zig-zag leakage reactance, in ohms:

$$X_z = 1.257 \times 2\pi \times f C_0^2 S_0 l \times \frac{1.7\ Q\ k_2}{d} 10^{-8} = 13.4 f C_0^2 S_0 l \frac{Q\ k_2}{d} 10^{-8} \qquad (3)$$

END-CONNECTION LEAKAGE.

Due to the influence of adjacent masses of iron and to the mutual inductance of the different phases, it is impractical, if not quite impossible, to calculate accurately the inductance of the coil end-connectors.

Experiments justify the assumption that the flux around the end-connections is 1 maxwell per ampere-inch of conductor for a full-pitch three-phase winding.

Assuming further that the length of the rotor end connection is 80 per cent of that of the primary there is obtained for the total end-connection leakage reactance,

$$X_e = 2\pi f l_1 \frac{(S_0\, C_0)^2}{2\, q^2} \times q \times 1.8 \times 10^{-8}, \text{ in ohms} \qquad (4)$$

$$= 2.83 f l_1 \frac{S_0^2\, C_0^2}{q} 10^{-8}, \text{ in ohms (per phase winding)}$$

for progressive windings where l_1 = length of the end-connection of one primary turn.

The inductance of any coil is dependent upon the relation $\dfrac{D_1}{S}$ where D_1 is the diameter of the coil and S the diagonal of the cross-section, and it varies approximately as the logarithm of the above ratio.

Expressing this ratio in terms of the machine dimensions and the number of phases, the value is,

$$\frac{D_1}{S} = \frac{\dfrac{\pi D}{q}}{\dfrac{\pi D}{q\, p}} = p$$

Introducing this factor, the leakage reactance in ohms becomes,

$$X^e = 6 f l_1 \frac{S_0^2\, C_0^2}{q} \log p\ 10^{-8}$$

BELT LEAKAGE.

Consider a primary and a secondary phase belt at the instant when they completely overlap; neglecting the magnetizing current their magneto-motive forces are then in exact phase opposition and the total leakage reactance consists of the three elements already discussed.

However, as soon as the secondary conductors move away from this position, so that a secondary phase overlaps two primary phases, the magneto-motive forces will not be 180 degrees apart in time phase; that is, the instantaneous value of the primary magneto-motive force will differ from that of the secondary, and local fluxes will be set up, which will link with unequal numbers of primary and secondary ampere turns. The result is a true inductive reactance, which is a maximum in the position shown in Fig. 3. By a transformation of the expression given by Prof. Adams, the average value of the total belt leakage reactance per phase winding for the primary and secondary is found to be

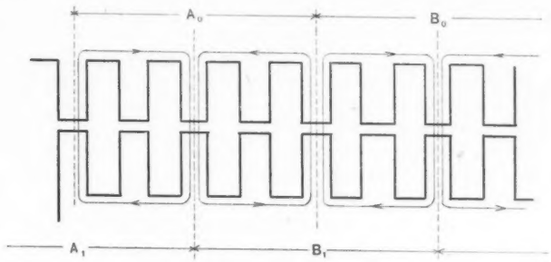


FIG. 3.—BELT LEAKAGE.

$$X_b = K\,K_1\,K_2\,K_3\,\frac{C_0^2\,S_0\,D}{q^2\,d}\,l\,f\,10^{-8} \qquad (5)$$

where:

K = a constant dependent upon the number of slots (see Fig. 4)

K_1 = slot opening constant $= -\dfrac{t_{01}\,t_{11}}{Q_0\,Q_1}$

Q_0 = primary tooth pitch in inches

Q_1 = secondary tooth pitch in inches

K_2 = iron constant (.8 to .95)

K_3 = .127 for three-phase, .42 for two-phase

D = diameter of the rotor in inches.

The above applies to machines having wound rotors. For squirrel-cage rotors a reasoning similar to the above may be applied; here all secondary currents, excepting the ones flowing in the rotor bars opposite the centers of the different primary phase-belts, are at some time-phase angle other than 180 degrees from the primary current, hence there is the same effect as in the case of a rotor having a regular coil winding.

Through a lengthy integration an expression is obtained which is exactly like the one given for wound rotors the value of K_3, however, being:

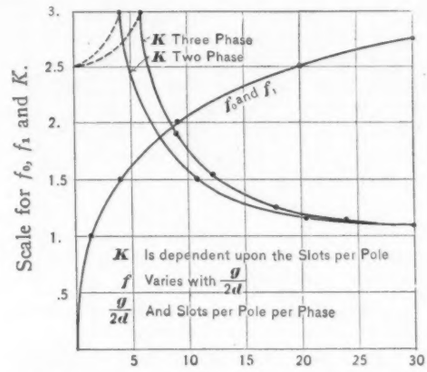


FIG. 4.—BELT LEAKAGE FACTORS AND FRINGING CONSTANTS.

$K_3 = .047$ for three-phase; .14 for two-phase.

Collecting the different formulæ there is obtained for the total leakage reactance per phase winding, in ohms:

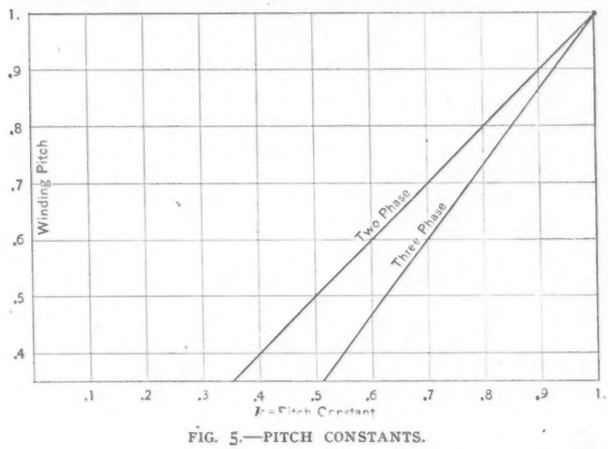


FIG. 5.—PITCH CONSTANTS.

$$X = f\,C_0^2\,S_0\,l\left[20\left(k_0 + \frac{P_0\,S_0}{P_1\,S_1}\,k_1 + \frac{13.4\,Q\,k_2^2}{d}\right) + 6\,\frac{l_1\,S_0 \log p_0}{q\,l} + K\,K_1\,K_2\,K_3\,\frac{D\,S_0}{q^2\,d}\right] 10^{-8} \qquad (6)$$

Data for Comparison of Calculations of Leakage Reactance with Test Observations.

Field Bore	Axial Length of Iron	Air Gap	Ave. width of slot. prim.	Ave. width of slot. sec.	Slot opening prim.	Slot opening sec.	Depth of Slot. prim.	Depth of Slot. sec.	T* prim.	T* sec.	Coils pr. slot.	Turns pr. coil.	Coils pr. phase	Slots pr. pole pr. phase. prim.	Slots pr. pole pr. phase. Sec.	Phases.	Poles.	Per cent. winding pitch.	CONNECTION **	X′ 50 Cycles.	X Cal.	Per cent. Error
4¼	1.82	.017	.50	.238	.125	.0625	.90	.238	.035	.035	2	60	8	2	2.58	3	4	83.3	Y	15.1	15.8	+4.6
"	2.86	.017	.50	.238	"	"	.90	.238	.035	.035	"	70	8	2	2.58	3	4	83.3	Y-P	7.77	7.77	0
5	3.15	018	.37	.238	"	"	.95	.238	.031	.059	"	40	12	3	3.58	3	4	77.8	Y-P	4.46	4.37	—2.
6	3.15	.018	.33	.272	"	"	1.14	.272	.03	.028	"	32	12	3	3.58	3	4	77.8	Y-P	3.	3.03	+1.
7	3.15	.019	.31	.272	"	"	1.15	.272	.03	.028	"	22	16	4	4.75	3	4	75.0	Y-P	2.12	2.05	—3.3
8	3.4	.022	.32	.302	"	"	1.25	.302	.03	.028	"	30	16	4	4.75	3	4	75.0	Δ-P	3.93	4.12	+4.85
5	2.62	.019	.37	.238	"	"	.95	.238	.031	.059	"	33	12	2	2.39	3	6	83.3	Y	8.	8.1	+1.25
6	3.15	.020	.33	.272	"	"	1 14	.272	.03	.028	"	40	12	2	2.39	3	6	83.3	Δ	16.6	15.1	—9.
7	3.15	.024	.31	.272	"	"	1.15	.272	.03	.028	"	26	16	2.666	3.17	3	6	87.5	Δ	9.28	8.82	—3.9
8	3.4	025	.32	.302	"	"	1.25	.302	.03	.028	"	15	24	4	4.75	3	6	87.5	2-cir.	1.23	13.3	+8.1
5	3.15	022	.37	.238	"	"	.95	.238	.031	.059	"	45	12	1.2	1.43	3	10	83.3	Y	14.1	15.2	+7.8
4¼	1.82	.019	.50	.238	"	"	.96	.238	.035	.035	"	42	8	1.	1.35	3	8	100.	Y	7.5	6.95	—7.3
5	3.15	021	.37	.238	"	"	.95	.238	.031	.059	"	45	12	6	7.16	3	2	38.9	Δ	13.	13.55	+4.2
20	4.5	.035	.312	.45	.312	.09	1.625	.50	—	.03	"	8	32	4	3.33	3	8	83.3	Δ-P	.915	.89	—2.73
20	6.	.035	.312	.45	.312	.09	1.625	.50	—	.03	"	7	32	4	3.33	3	8	66.6	Δ-P	.592	.64	+8.1

* T is the thickness of the overchanging part of the tooth.
** Y is star connection; Δ is delta connection; Δ-P is two halves of each phase winding in parallel, phase winding then in delta; Y-P is two halves of each phase winding in parallel, phase winding then in star.
NOTE—All dimensions are in inches.

So far the effect of fractional pitch of the winding has not been considered. In the case of the end connections, this effect can be taken care of by introducing the pitch, as a decimal, into the expression log (p), making it log ($k_3\,p$).

Considering a full-pitch winding, it will be noticed that all of the conductors in any one slot belong to the same phase winding and in consequence the currents in all the conductors are in time-phase. With a fractional pitch winding, however, this is no longer the case, the currents here being out of time-phase with each other, due to the fact that some or all of the slots containing conductors belonging to different phase windings.

Taking these considerations into account, the result obtained from formula (6) must be multiplied by a constant k, the value of which is given in Fig. 5. The complete formula will thus become:

$$X = k\, f\, C^2\, S_n l \left[20\ \left(k_0 + \frac{p_0 S_0}{p_1 S_1} k_1\right) + 13.4 \frac{Q\, k_3}{d} + \frac{6\, l_1 S_0 \log\,(p_0 k_2)}{q\, l\, k} + K\, K_1 K_2 K_3 \frac{D\, S_0}{q^2\, d} \right] 10^{-3} \qquad (7)$$

This formula has been checked on a large number of squirrel-cage-rotor motors, varying in size from ¼-hp to 75-hp, and it has in each case given good results.

Aspects of Recent Telephone Development.

By Howard S. Knowlton.

An exhaustive report, entitled "Telephone Competition in the Middle West and Its Lesson for New England" was recently prepared for the New England Telephone & Telegraph Company, by Mr. George W. Anderson, of Boston, in connection with a project of various independent telephone interests to secure a franchise in the city of Boston. The report was naturally unfavorable to competition in the telephone field, but it contained in addition to its main argument against competition so many interesting side lights upon the conditions of modern telephony that it seems worth while to touch upon some of these, leaving the issue of competition aside for the time. So rapid has been the development of the telephone industry that few persons whose daily work lies outside that field, realize the extent to which that organization has stepped in and systematized both the broader economic and the more specialized technical problems of the art.

Many popular misapprehensions still exist as to the nature of telephone traffic. It is perhaps unfortunate for the common understanding of telephony that originally the telephone was regarded as a patented and leased instrument, fastened to the wall, which when once installed could be used ad libitum without putting anyone to substantial expense. Of course, when a telephone is a private instrument, connecting one's house and stable, for example, its popular conception is in the main true. But the moment the telephone is connected, not with one or two other telephones, the real telephonic apparatus used in communication is mainly concealed from the ordinary subscriber. It is located under ground, on pole lines, in the intricate devices of the switchboard, and in the trunk lines connecting the various switchboards.

The cost of installing a telephone for a subscriber, therefore, constantly increases as it becomes necessary to be able to connect that subscriber with an increasing number of other subscribers. At its simplest the switchboard is the terminal of three subscribers' lines, with an operator to connect any two lines together. With two subscribers there is one connection possible; with three subscribers, three connections; with four, six, and so on according to the mathematical formula of combinations. Applied to an exchange of 1,000 or other large number of subscribers, this works out an enormous number of connections possible between different subscribers, which ought in theory to take place in a single day. Practically they would not take place, either in a single day or at any time, because no one person wants to talk with 999 others of a given 1,000. The average number of daily calls over a single telephone increases as the number of subscribers increases, but not in the same proportion. We cannot talk to each other all the time, but it is the function of telephony to make possible, almost instantly, voice-to-ear communication of tens of thousands of subscribers among themselves, and all at the same time in the busy hours of the business day. In Boston and its suburban districts, for example, this means upwards of 80,000 subscribers in constant touch with one another.

This condition requires a large number of operators and a large amount of equipment. Experience has shown that one operator can answer the calls on from 40 to 100 different lines. Each operator must, therefore, have within physical reach of her hand, jacks in the switchboard enabling her to connect her incoming calls with all the rest of the subscribers in that exchange. At present an exchange is practically limited by the length of the human arm and the size of the plugs and jacks to about 10,000 lines and the necessary trunk connections. It is consequently necessary to repeat within the reach of each operator the connections with the entire number of subscribers in that exchange, with whose lines each operator must have capacity to connect the 40 to 100 subscribers' circuits whose incoming calls she answers. It is apparent on slight analysis that the larger the number of subscribers in any exchange the more complicated, difficult and expensive is the process of adding new subscribers. The installation of the tenth hundred of the telephones costs much more than the first hundred, and so on. The cost per subscriber for a central office switchboard may run, including the toll and trunking lines, from $5 in an exchange of 200 subscribers, to $30 in an exchange of 15,000 subscribers. When the practical limit of one exchange is reached, about 10,000 lines, the connections are made by trunking between exchanges. In the Boston metropolitan district, for example, there are now 96 exchanges, and the amount of intertrunking between exchanges and of operators to handle interexchange business, has to be increased as the number of subscribers increases, but this increase of equipment never bears an arithmetical ratio to the increase in the numbers of subscribers. The system grown constantly more complicated, as almost instantaneous interchangeability of speech is created between larger and larger numbers of people. Not only does the cost of installation increase as the number of subscribers increases, but the cost of operation goes up. Telephony is thus differentiated from every other business.

Not only a little popular misapprehension, both as to what are fair telephone rates, and as to the desirability of completion, has grown out of the common failure to recognize what the problem of telephony really is. There is much reason to believe that the telephone companies have, to their own embarrassment and injury, failed to do all that they might have done, to give the intelligent public a reasonably adequate comprehension of this situation.

Obviously this increase in cost, both of installation and of operation, makes the financial problem in telephony entirely different from that which obtains in any other kind of business. It is difficult on first stating it to make an ordinary intelligent man believe that it costs more per subscriber to do a large telephone business than to do a small one. He says, and with truth, that a street railway can carry 100,000,000 passengers more cheaply per pasesnger than 10,000,000; that a gas or an electric light company can sell their products more cheaply as their outputs are increased; and he therefore has difficulty in seeing why the telephone company, as it increases its numbers of telephones, is not likewise increasing its ratio of profit, if its rates are being kept up. Increasing business and decreasing rates have come to be almost axiomatic in the mind of the public.

Much of the popular confusion grows out of the practice, almost universal in the West, and still to a large degree prevailing in New England, of reckoning the telephone business by the number of subscribers, instead of by the number of messages. What the telephone companies are really doing is selling service to their subscribers, i. e., transmitting messages among their subscribers. When the telephones are put in at a

flat rate and the subscriber is permitted to have unlimited service there is an analogy, not exact, but still instructive, between the condition of the telephone company and the condition a gas company would be in if it reckoned its business by the number of gas consumers it obtained, and then allowed them to draw through the pipes, gas without any limit; and so with an electric light company; it is clear that it cannot base its rates upon the number of lamps outstanding, but upon energy furnished. To a considerable degree the same thing is true in telephony. If the public had not been brought up to believe that the telephone on the wall or desk is, unused, like a clock stopped, and used, like a clock going, so far as the cost of operation is concerned, the difficulties of telephone companies and customers would have been much less than they now are.

Broadly speaking, the unit in telephone traffic is the telephone message, just as the unit in the gas business is 1,000 cu. ft. of gas, or in the street railway business, a single passenger; or in the postal business a letter or a postal card. No intelligent person thinks himself entitled to have his letters transported without the payment of postage to any particular point, simply because the government has established postal service to that point. Nor would it appear reasonable to pay to the government an annual rental for having a post box put up on one's piazza, and thereby become entitled to send and receive letters from all over the country without regard to the number received or sent. But the most scrupulous office boy, whose conscience would quiver at the thought of taking a postage stamp, will thoughtlessly visit with all his chums and discuss the baseball score, over the telephone, through a complicated system in which service costs just as truly as postal service costs. The United States census of 1902 reports that the average operating expense per message was 1.121 cent for the whole country. In the year 1902 the population of Massachusetts—a little less than 3,000,000—had by telephone about 185,000,000 talks, or an average of 63 messages per capita and of 1,897 messages per telephone; and the average actual cost of the message was 2¼ cents each.

A telephone message is more than equivalent to a letter and its reply, or a telegram and its reply. A letter and its reply costs 4 cents; to send a letter and get a reply, even from Hingham to Woburn, both in the Boston metropolitan exchange area, involves not less than 24 hours, and probably the better part of two days; to say nothing of the time of each writer taken, in writing and mailing the letters. To exchange telegrams between the same points takes hours, besides the time of each sender in writing and getting his message to the telegraph office generally some distance away; each message, of course, depending upon delivery by the tardy and reluctant feet of the messenger boy, and costing 50 cents for 20 words. When the advantages of telephone communications are considered, is it to wonder that we find that in the year 1902 there were about 92,000,000 of telegraph messages and more than 5,000,000,000 telephone talks; or, reckoning each telegraph message as only half a telephone message—which is in many ways fairer—there were but 46,000,000 telegraph messages, or more than 100 times as many telephone as telegraph messages?

It is remarkable that the public should so generally believe that telephone communication costs little or nothing, except to install the apparatus, while it fully understands that telegraph messages do cost. It ought to be clear that this equipment necessary to bring any one of a million people into almost instantaneous communication with any other one of that million, must both in installation, and operation cost as certainly as the service of telegraph operators and messenger boys makes necessary a reasonable charge for a telegraph message. The popular delusion relative to telephone service costing nothing has resulted in at least three obviously bad results:

1. There is a vast amount of talk over the telephone which serves no useful purpose whether either social or commercial, in many places it is used almost as freely as the air in communicating the human voice. This throws upon the companies a heavy burden of useless messages, increases the expense of operation, makes party lines annoying and unsatisfactory, causes complaints as to the alleged defects of the service which are not defects at all in the service itself, and in the long run increases the general cost of telephone service which either investors or users must pay for.

2. Failure to recognize that increased means of communication means an increasing ratio of cost of both installation and operating expense for telephones, has led the public to believe that really reasonable rates are entirely unreasonable when in not a few instances the rates are insufficient to provide for proper service without endangering the rights of investors in telephone securities.

3. It has also resulted in very serious financial losses to persons who have in good faith invested their savings in telephone companies originally starting with a small number of subscribers paying low, flat rates, which rates have been continued with increasing number, until the increased operating expense has eaten up the capital invested. As the telephone business legitimately managed has grown at an appalling rate, it is easy to see how inexperienced persons forming a company and starting with the expectation of having, say, 500 subscribers, and charging the low rate of, say, $12 to $24 per subscriber per year, when called on from time to time to see the capital increased, would thus be deluded into believing that the new capital was really being used for extending the plant, whereas in reality no inconsiderable part of it was being consumed in the increased operating expense. This unexpected, unperceived and yet absolutely inevitable increase of operating expenses has worked dire disaster in many of the smaller telephone companies and in not a few of the larger ones.

The subject of telephone rates involves infinitely more difficulty than railway or electric light rates. It is obvious on a not very critical analysis and from the statements of many telephone men, both Bell and independents, that telephone charges must tend towards a message rate basis; that in telephony as in any other kind of service furnished, in the long run people must pay for what they get, and the charge must be based upon what is furnished. It ought not to be overlooked that the general public is more interested in having an adequate telephone system than in getting rates for a short time below actual cost. Nothing is clearer than that it is for the benefit of the people as a whole to have the telephone system extended as far and as fast as may be. This can only be done by the investment of enormous amounts of capital. Capital cannot be obtained unless it is safely invested and made reasonably remunerative. If because of public delusion as to telephone service costing nothing after a telephone is once installed, companies yield to pressure for rates which are too low, financial dishonesty is sure to result; the development of the telephone system will be checked for lack of capital and thus this great agency of civilization and of social and of economic comfort and progress prevented from having its proper and adequate development.

Few greater national disasters can be imagined than that the development of the telephone business should be checked by the inability to obtain capital for extensions. Telephony has within the last thirty years revolutionized business methods, largely destroyed the ghastly isolation of farm life and brought us all into intercommunication with each other; so that the condition in which we were thirty years ago, as compared with the condition in which we now are, is analogous to the feeling that one has on coming back to one's native language after spending a time in a foreign country where communication is limited to a trifling few. Formerly we might communicate with a few; now almost instant communication is well nigh universal.

It ought to be pointed out that if and when telephone rates are put upon a message basis and the public comprehends that the transmission of telephone messages costs, that then the "wholesale" idea that increasing business should bring decreasing rates, would be found once more true as applied to the telephone business. As it is now the public does not under-

stand the basis of telephone rates. Consequently it is suspicious, and misunderstanding breeds distrust in the public toward public corporations and works out injury in the long run to both public and corporation. There must be mutual understanding and confidence, or there is economic waste. It may be that there are adequate reasons why message rates cannot be made more nearly universal than they now are. But if there are not such reasons it is very clear that there is a distinct advantage in getting rates upon a basis so that the commonly accepted idea that the larger the business the greater the profit, and consequently the less the charge, should be the correct idea. If 2 or 2½ cents be a fair average rate for telephone messages, and this be once shown to the public, it will accept that rate, reasonably expecting that when the traffic has doubled the rates will diminish, unless it shall appear (and it may very possibly appear) that the area of intercommunication at the wholesale rate has been so extended that the rate ought not to decrease. Telephone rates would be subject to the same or analogous economic laws as street railway rates. The point is that the nearer the principles underlying prevailing telephone rates accord with the principles underlying railway and similar rates, the easier it will be for the public to understand the subject, and the less difficult it will be to establish amicable and cordial relations between the public and telephone companies.

Compound-Wound Motor-Generators.

By R. S. Wallace.

The Peoria (Ill.) Gas & Electric Company, several years ago, when enlarging its station, found it desirable to unify its generating machinery so as to have all generating units three-phase, alternating current. In making this change, there was a considerable 500-volt direct current power business which had to be taken care of, and this was done through motor-generator sets consisting of three-phase, synchronous motors, driving 500-volt direct-current generators. The motors, which had previously been used as generators, were of the revolving armature type and each of 150 kw capacity.

Many elevators were supplied from the 500-volt direct-current service, and the rapid fluctuations in load on the motor-generators caused considerable variation in the three-phase bus voltage from which the lighting service is supplied. In order to prevent this, a series winding was placed on the fields of the synchronous motors. This winding was connected in series with the direct-current generator, so that the current delivered by the generator flowed around the motor field, over-exciting it and inducing a leading current in the motor armature, proportional to the load on the direct-current generator, and which reacted on the three-phase generators, thus maintaining a constant voltage on the three-phase bus-bars regardless of the load carried by the direct current generators.

The number of turns and the current required for this series winding were determined by manipulating the field rheostat of the synchronous motor, and observing the increase of motor field current necessary to maintain the three-phase bus voltage constant while the load on the motor increased from zero to full load. The number of turns in the shunt-field winding of the motor being known, the ampere-turns necessary to produce the desired result were easily determined and the series winding was proportioned accordingly. On account of there being insufficient space between pole pieces on the motor for a conductor large enough to carry the full-load current of the direct-current generator, a larger number of turns of a smaller conductor were wound on each of the poles and a shunt placed across the terminals of the entire series winding as is customary practice with the compound field winding of a direct-current generator.

It was determined by experiment with the motor field rheostat, that each motor would require 18,000 ampere-turns to produce the desired results, and as the motor had 12 poles, each was given 10 turns and the shunt proportioned to give the series field winding 150 amperes with full load on the direct-current generator. Slight changes in the shunt, after the machine was put into operation, gave the result sought for without difficulty. As these motor-generators are usually started from the direct-current end, this motor field winding was connected in the same lead as the series winding on the direct-current generator field, and the starting current applied through the equalizer, the equalizer bus being on the switchboard; the series windings on both motor and generator being thus left out of circuit in starting, they have no neutralizing effect on either field.

Since this arrangement was adopted, a storage battery has been installed, which lessens the fluctuations in direct current load on the generators, and a Tirrel regulator controls the three-phase bus voltage. It is, therefore, not so essential to good regulation as formerly, but when first installed it was of very great assistance.

The Power Plants of the Joslyn Manufacturing Company.

An interesting application of electric power to mill service is that of the Joslyn Manufacturing Company, located in South Scituate and Hope, R. I. The company operates three mills for the manufacture of shoe laces and corset strings: the Richmond Mill, on the Ponogansett River; the Ponogansett Mill, situated on the same stream two miles above; and the Rockland Mill, situated on the west about three-quarters of a mile from the Ponogansett Mill. The installation is worthy of special consideration, first, because of the efficient method of operation, and, second, because these mills are among the first to adopt the use of high voltage motors inside the buildings to operate the machinery.

These three mills, like many others, depend upon two sources of power to drive them, namely, water power ordinarily and steam power when the water power fails during the dry season.

The Rockland Mill, which is situated between the two other mills, contains a small power house in which is installed a water-wheel-driven 10-pole, 200 kw, 720 r. p. m. 2300-volt three-phase alternator, with a switchboard. A 175-hp 2080-volt, 12-pole, 600 r. p. m. induction motor supplied from this generator drives the mill. A steam engine is held in reserve to the water power for driving the generator, but it will probably never be used, as at dry periods all of the available water is utilized by this mill alone, the pond near the Ponogansett Mill serving as a storage reservoir against the dry periods. The Rockland Mill power station thus supplies power to operate the Rockland Mill and to assist in operating the other two mills all the year around.

The Richmond Mill runs 24 hours per day ordinarily, using water power, but has an auxiliary steam engine, also a 75-kw synchronous motor, 8 poles, 900 r. p. m., also used as a generator. When the plant is operated by water-wheel, this unit is belted to the line shaft, and runs in multiple with the 200-kw generator installed at the Rockland Mill, helping to take its share of the load. When the water is low, this unit is used as a motor supplied from the Rockland Mill generator, the Richmond Mill steam engine being very seldom used. The idea is to get along without the use of the engines. This building is lighted through a 20-kw transformer supplied by the transmission line which connects the three mills.

The Ponogansett Mill operates ten hours per day and depends entirely on waterpower when available. In this mill is a 60-hp induction motor, also a 100-kw synchronous unit, which is used as a generator, or as a synchronous motor to drive this mill when water is low, operating in multiple with the units at the other mills, and thereby helping out in saving coal or water, as the case may be, for the other mills. This building also is lighted by current transformed from the transmission line. The 100-kw unit is an 8-pole, 2080-volt machine making 900 r. p. m., and the 60-hp motor is a 10-pole, 720 r. p. m. outfit.

The transmission line enters each mill in rubber insulated

lead-covered cables, laid in loricated galvanized iron conduit with the sheath grounded. The motor frames are also grounded to eliminate danger of fire or shock. The electrical equipment of these plants is all of General Electric manufacture. The use of induction motors and synchronous motors of the revolving field type is a strong element in the safety of the installation.

Chicago Meeting of Illuminating Engineering Society.

The Chicago section of the Illuminating Engineering Society held its March meeting on the 14th at the Association Restaurant banquet room, following a dinner at 6 p. m. The papers discussed were those presented at the New York section March 8. Mr. S. H. Moore, of the People's Gas Light & Coke Company, read the papers by Messrs. Wm. J. Clark and Charles M. M. Cohn on the lighting of the gas company offices in New York and Baltimore.

Mr. V. R. Lansingh criticized the statement in Mr. Cohn's paper that the efficiency of the mantle burner made the matter of light absorption by suitable shades a matter of little importance. Almost any one could get results by spending enough money; it was the engineer's task to get results with economy. He suggested that the use of inverted burners would make a great difference in the economy of lighting in the Baltimore gas offices. With the inverted burner about 65 per cent of the total light would be thrown below the horizontal and 35 per cent above; while with the upright burner 45 per cent goes below the horizontal and 55 per cent above.

The paper by Mr. E. A. Norman, comparing several different methods of electric lighting in the New York Edison Company offices was read by the secretary. Mr. Lansingh, who was present at the tests described in this paper, said that before the test new lamps were put in all through and the cove was thoroughly cleaned out, so that conditions were better than normal. The cove was found to be exceedingly dirty and that, too, in a comparatively clean city. What it would have been in Chicago could easily be imagined. He favored covering such coves with thin glass, which would keep the dirt out of the trough, where it was difficult to get at. This glass could be easily wiped off and the absorption of light in the glass would be nowhere nearly as great as the loss by dirt in the cove. The comparison in the paper of the ratio of efficiency, viz., 100 per cent for ceiling lighting with reflectors, 32 per cent for cove lighting, and 69 per cent for cluster lighting, was hardly fair to the clusters, since two of the clusters were not over the space illuminated and only part of their light was effective in illuminating the portion of the room in which the measurements were made. Subtracting the ineffective cluster lamps from the total wattage would bring the efficiency of the cluster lighting 104 per cent on the foregoing basis. He said it was the opinion of every one connected with the test as well as those staying in the room that the indirect lighting was trying on the eyes. The clusters had been put in to give positive direction to the light.

Mr. W. D'A. Ryan said that the object of indirect lighting in the room in question was for spectacular and unusual effect rather than for office working purposes, since the room was seldom used at night. The lighting was designed simply as an advertisement. As to the drafting room lighted with concentric diffusers, the illumination was higher than it need be, but for the fact that there was a skyline along two sides of the room; and it can be accepted as an established fact that where there is a strong skyline, it necessitates more powerful artificial illumination when there is a mixture of daylight and artificial light. As a rule, an expenditure of from 2 to 2.5 watts per square foot instead of 8 watts per square foot, as in this case, would give good results. The illumination in foot-candles in this room could probably be run up to 30 with the use of different shaped concentric diffusers, allowing less light to go up; but the diffusion would not be as good and there would be more pronounced shadows.

He agreed with the statement made by Mr. Lansingh that indirect lighting as totally diffused light is trying on the eyes and undesirable. The effect is that obtained on a day when the sun is shining through a thin fog and the eye cannot find relief from the light coming in from all directions. Furthermore, indirect lighting is too expensive. Mr. E. Lloyd gave some data recently received on the lighting on the New York Central drafting room in New York with Moore vacuum tubes. The area lighted is 2078 sq. ft. and length of tube 138 ft. The ceiling is 16 ft. 5 in., the tube 10 ft. from the floor. The watts per square foot were from 1.45 to 1.6, according to the rarefaction of the tube. The watt consumption and power factor of the tube depend on the color of the light, which in turn are dependent on the degree of rarefaction in the tube. With white color the power factor was 41.5 per cent and with red color 56 per cent. The illumination is not quite sufficient for detailed work, so that the men are obliged to use also the ordinary incandescent lamp.

Mr. George W. Keech cited the drafting room of the North Works of the Illinois Steel Company as an example where very satisfactory lighting had been obtained with mercury vapor lamps with an expenditure of 1.54 watts per square foot. No individual incandescent lamps were necessary. The results were so satisfactory that the company asked to have the arrangement duplicated in its South Works. The tubes were in this case placed above the windows so that the light at night would come from the same angle as in the daytime—from the front and left of the draftsmen.

Mr. J. R. Cravath said that a comparison on the basis of average foot-candle per watt, as in Mr. Norman's paper, does not offer any opportunity for comparing rooms of different sizes. In order to get a basis for comparisons and preliminary calculations, it had been his practice recently to figure for each installation the ratio of watts per square foot to the average illumination in foot-candles in the measured plane. The multiplying factor he uses is determined by dividing the average foot-candle illumination by the watts per square foot. The result is the factor by which we may multiply the watts per square foot in a given type of installation to obtain the average foot-candle illumination resulting. For the installations described in Mr. Norman's paper, these multiplying factors are as follows:

Cove lighting	0.51
Ceiling lamps with reflectors	1.6
Clusters, as figured in paper	1.1
Clusters with corrections suggested by Mr. Lansingh	1.6
Drafting-room, concentric diffusers	1.7

It is also interesting to note the multiplying factors on several other installations. For the room in the New York post-office equipped with mercury vapor lamps, which was tested by the same laboratories, the results on which were given in the November, 1906, *Transactions* of this society, by Mr. J. E. Woodwell, the multiplying factor is 4. This high figure is due, of course, to the high-efficiency of the mercury vapor lamp as a source of light. It is also interesting to compare the ceiling installations with reflectors given in Mr. Norman's paper with the ceiling installation without reflectors given by Mr. Preston S. Millar's paper before the society in December, 1906. Without reflectors the multiplying factor is only 0.6, as against 1.6 for the ceiling installation with reflectors. He also called attention to certain figures given in the discussion before the Northwestern Electrical Association last January by Mr. F. W. Willcox on the lighting of a large room in Marshall Field & Company's store. Here "Gem" high-efficiency incandescent lamps in bowl reflectors were scattered over the 15-ft. ceiling. The average illumination in foot-candles on the counters was twice the watts per square foot; or, in other words, the multiplying factor was 2. With common 3.1-watt incandescent lamps in deep, sand-blasted dome shades pointed at an angle of 45 degrees on chandeliers hung low over the counters, the multiplying factor was 1.2. This low result was partially due to the obstruction of the light by the goods and shelves.

Catenary Line Work for Electric Railways.

In a lecture by Mr. W. S. Murray before the Electrical Engineering Society of Columbia University on Wednesday, March 6th, much interesting information was given concerning the catenary line construction used on the single-phase section of the New York, New Haven & Hartford Railroad. The lecture was well illustrated, numerous views being shown of the locomotive and of the overhead work. The locomotive is designed for use over the tracks of the New York Central Railroad in the neighborhood of New York where a third-rail equipment is used. Throughout the alternating current zone of the New Haven Road the locomotives will receive current from an overhead catenary structure. Fig. 1 gives an end view of a locomotive showing the third-rail contact shoes turned up at an angle of about 40 degrees, which position gives the proper running clearance to the locomotive over the New York, New Haven & Hartford alignment. It will be noted that the pantagraph mechanism is extended so that the alternating current contractor reaches the overhead delta catenary construction.

The overhead wiring is supported at points 300 feet apart by means of bridges made of lattice-work. A general view of the

FIG. 1.—LOCOMOTIVE WITH PANTAGRAPH TROLLEY AGAINST WIRE.

catenary construction is given in Fig. 2. At every two miles the overhead bridge is of special form and is used both to anchor the line work and to contain switches for the purpose of disconnecting the trolley circuit or interconnecting them with feeders as may be desired. Use is made of section insulators consisting of wooden rectangles suspended directly beneath the anchor bridge in line with the trolley wire. A 110-volt electro-pneumatic operating device is provided for controlling each sectionalizing switch. At each anchor bridge there is arranged a complete encircling bus to which can be connected the feeders and to which each section of the overhead work is normally joined. When so desired the track switches may be opened at two adjacent anchor bridges and thus any section of track may be rendered dead; while the bus allows the feeder circuit to form a shunt around the overhead work for furnishing continuity of transmission beyond the disconnected section. The 110-volt circuit is controlled from a panel in the regular signal tower adjacent to the anchor bridge, and thus it is possible to stop any train on any section when emergency may require.

A No. 4-0 wire is used for the contact conductor; the feeders, however, are of No. 2-0 wire. The larger size was used for the contact conductor on account of the required mechanical strength and not because so great a conductivity was needed. A delta-formed catenary structure serves to support the contact conductor. The main support is provided by two steel cables to which the copper contact conductor is joined at frequent intervals as shown in Fig. 2.

On account of the fact that some of the overhead bridges span as many as seven tracks, it will be appreciated that extra-

FIG. 2.—VIEW OF LINE WORK TAKEN FROM ANCHOR BRIDGE.

ordinary means had to be employed in their erection. For the purpose of placing the side poles in position on their concrete foundations and for lifting the overhead bridges into place, use was made of the locomotive crane shown in operation in Fig. 3. The locomotive crane served for lifting the steel fabricated posts from the flat cars and carrying them over to the proper foundations.

Fig. 3 indicates ont of the most difficult problems encountered during erection, where the side post is just being placed on its foundation. It will be noted that the beam of the locomotive crane does not even clear the station shed, and yet the horizontal distance from the end of the crane to the foundation is at least 25 ft. The lattice-work post was first balanced at its central point and lowered to the ground on the foundation side of the shed. By means of sheave block and hitch connected to a conveniently located tree in a yard adjacent to the station grounds, an improvised telpher system allowed the mass to be drawn over to a point sufficient to permit the post to be swung towards the

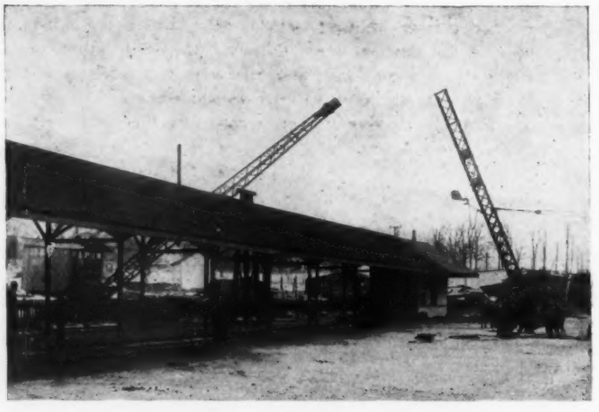


FIG. 3.—DIFFICULT CONSTRUCTION WORK.

foundation in pendulum order, the last act in the performance being shown in the figure indicated.

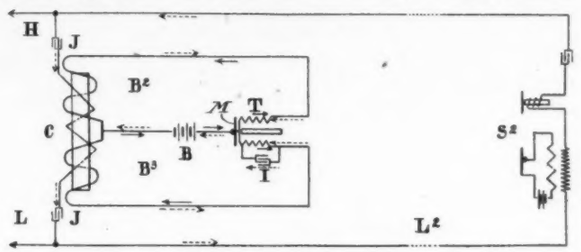
After the side posts have been erected, the truss is lifted from the flat cars, balanced in the air, raised above the ends of the post and subsequently lowered into position. The whole operation of lifting a truss from the car and lowering it into position consumes about 15 minutes. The work of erecting the bridges has been accomplished by the McClintic Marshall Construction Company, under the immediate direction of Mr. G. W. Tracy.

New Telephone Patents.

REPEATER CIRCUIT.

This long famed repeater problem has always included two difficulties: First, that of obtaining a successful instrument, and second, that of discovering a successful circuit in which to work it so that it may transmit both ways. The chief difficulty with a straightforward circuit is that of howling of the repeater due to the receiving part responding to the reinforced output of the forwarding part. A similar difficulty had to be overcome in telegraph repeaters, but in the telephone case it is more difficult because it must be done electrically and not mechanically. The problem involved may be stated briefly as follows: The repeater must be so connected that while its receiving part will respond to any current coming toward it from the line, it must not respond to any of its own output to this same line.

Mr. N. G. Worth, of Columbus, O., thinks he has solved the problem by the arrangement shown in Fig. 1. Here the in-



WORTH REPEATER SYSTEM.

coming current passes through one coil of a repeating coil of peculiar construction. There is correspondingly induced in the second and third coils equal and opposite effects, these two latter being oppositely connected. These induced currents are shown by arrows, and they proceed toward the two differentially connected receiver coils. These alone would therefore cancel, were it not that the balance of the receiver is destroyed by the condenser. The telemicrophone responds and sends out variations in the battery current. For these it will be seen that the coil secondary and tertiary act in unison and therefore inductively affect the primary, causing it to supply the line with rejuvenated currents. Now, it is claimed that the battery currents will neutralize at the differential receiver and thus there will be no "howling." It is difficult to see how this can be the case, because there is a disturbing condenser present. This, it would seem, must be almost as effective in unbalancing the receiver for pulsating as for alternating currents, especially if we consider the former as merely an alternating current superimposed upon a direct current.

SWITCHBOARD CIRCUITS.

From time to time we have noted patents granted to Mr. W. W. Dean, in which the test relay for busy testing, was controlled in its relation to each cord pair by an auxiliary ringing key contact. We now have at hand the patent for this system. The tip or test strand is wired through the forward contacts of an auxiliary relay, the tip connection taking the moving contact, and the rear contact the test relay wire. Thus as long as the auxiliary relay is not energized the tip or test is connected to the test relay and to nothing else. The auxiliary relay circuit is carried through one of its own forward contacts so that once operated, it locks itself during the connection. The ringing key extra contacts are in shunt to the auxiliary relay control contacts. Thus at the act of ringing, the auxiliary relay operates and remains locked after the key is released. This patent is assigned to the Kellogg Switchboard and Supply Company.

Two other patents, these for trunking circuits, assigned to the above company, have been granted respectively to Messrs. F. W. Dunbar, of Chicago, and H. C. Goldrick, of Indianapolis. These circuits cover special cases for calling circuit trunks connecting Dunbar two-wire common-battery switchboards to other special types of boards. The circuits, especially that of Dunbar, are well conceived, and provide the usual ringing, disconnect and through supervisory circuits.

SUBSTATION CIRCUITS.

E. R. Corwin, of Chicago, has received a patent for a common-battery substation set in which the receiver and transmitter are in series in the line, a low-resistance impedance coil shunting the former to such an extent that the proportionate direct current flowing through it is negligible. The circuit therefore includes no condenser in the receiver circuit. An additional feature lies in a switch hook arranged so that the making and breaking of the receiver circuit follows and precedes respectively that of the transmitter circuit, so as to avoid clicks.

A lock-out system for party lines forms the basis of a patent to M. P. Boone, of Peru, Ind. The receiver hook has an indirect action upon the hook switch parts, through levers under control of an electromagnet. The energization of this latter at each station occurs as long as any receiver is off the hook. This is brought about by connecting the coil between the grounded side of the line and ground. As soon as current is returning over this grounded side, sufficient of it is shunted off through the lock-out coils to offset them.

COMPOSITE CIRCUIT.

With composite working of telephone circuits, it has always been found necessary not only to protect the telephone bridged circuit from the telegraph currents by condensers, but also by connecting a grounded neutral point at either side of the telephone instrument. These grounds are made through low-resistance, highly inductive coils, and serve the purpose not only of helping to free the telephones from telegraphic distrubance, but also to keep the condenser discharges of the telephone circuit from creating disturbances on the telegraph circuits. This disturbance referred to is, of course, a sort of cross disturbance between the telegraph legs.

Now, with common-battery signalling it has been found that these impedance grounds spoil the flexibility, and in order to overcome this defect Mr. G. M. Yorke, of New York City, has introduced condensers in series with the neutralizing retraction coils. These condensers he finds do not disturb but rather enhance the action of the coils, and yet maintain the circuits impervious to steady currents. Mr. Yorke has assigned his patent to the American Telephone and Telegraph Company.

LETTERS TO THE EDITORS.

Measurement of Cable Insulation.

To the Editors of Electrical World:

SIRS: The article on "Measurements of Wire and Cable Insulation," by Mr. F. Wachter, in your issue of March 23, is certainly calculated to surprise the profession, if the statements therein contained be true. With an insulation resistance of 800 megohms and a testing e. m. f. of 200 volts, the current would be, according to the accepted method of calculation, one four-millionth of an ampere. That this current could produce any measurable drop of potential, in one mile of any commercial size of copper wire, is certainly a surprise to the electrical profession.

The writer is strongly inclined to agree with the explanation of the matter given in your editorial, published in the same issue. This inclination is strengthened by practical experience in testing in insulating mills. The usual mill practice is to dry (?) the ends of the wire by holding them in the naked flame of an alcohol lamp for a short time. It is a well known and elementary fact in chemistry that the first action of a naked flame is to deposit moisture on any cold object with which it comes in contact; hence, there is no certainty of drying the ends by this method, unless they are held in the flame until thoroughly heated. Even then, it is not always certain; the writer has several times tested cable, on damp summer days, which could

not be made to test up to specifications, even by the most persistent lamp-flaming. As soon as the weather would change, and the air become dry, the cable could be tested all right, although nothing had been done to it. In one case, a reel of finished cable was tested, standing on the bare earth in the yard of the mill, the test showing low insulation, in spite of repeated lamp-flaming. It was finally discovered that the free end of the cable projected over a puddle of water and only a few inches above the surface of the water. As soon as the reel was rolled over sufficiently to bring the free end on top, the cable tested high enough to be accepted. The cause of the first test showing low was the minute quantity of moisture which condensed on the cable end, from the vapor rising from the puddle.

New York City. Townsend Wolcott.

Calculation of Auxiliary-Pole Windings.

To the Editors of Electrical World:

Sirs:—The writer of the article entitled "Calculation of Auxiliary Pole Windings," on page 508 of your March 9 number, has, I believe, made an error in the hypothesis, which is continued throughout his article.

In the first sentence following formula (1) in the second column of page 509, the author states that the frequency of commutation is $\frac{b\,n}{120}$, that is, that half the number of coils commutated per second is the "frequency of commutation." The author does not so state, but I assume he intends n to be the speed in r. p. m.

It is assumed that a coil commences to commutate as soon as the brush has bridged the mica between bars of that coil and completes its commutation when the mica has advanced across the brush face to the point where the brush no longer bridges across the mica, then the distance traveled by a point on the commutator surface during commutation is the brush width less the width of the mica.

This point on the commutator travels, in inches or centimeters, at the rate of

$$\frac{\pi \times \text{Commutator dia.} \times \text{r. m. p.}}{60} \text{ per second.}$$

The actual time the coil is undergoing commutation is then:

$$\frac{\text{Brush-mica}}{\frac{\pi \times \text{Commutator dia.} \times \text{r. p. m.}}{60}}$$

This is only half an "alternation." The time for a complete alternation is:

$$2 \times \frac{\text{Brush-mica}}{\frac{\pi \times \text{Commutator dia.} \times \text{r. p. m.}}{60}}$$

The frequency is,

$$\frac{1}{\text{time}} = \frac{\pi \times \text{Commutator dia.} \times \text{r. p. m.}}{2 \times 60 \text{ (Brush-mica)}}$$

and not as the author states.

Using this value for the frequency, the author's formula (2) becomes

$$e = \frac{I}{2a} \cdot \frac{\pi^2 \times \text{Commutator dia.} \times \text{r. p. m.}}{60 \text{ (Brush-mica)}} L\ 10^{-8}$$

and formula (3) becomes,

$$B = \frac{I}{2a}, \frac{\pi \times \text{commutator dia.} \times T}{\text{(brush-mica)} \times D}$$

This revision applies to the remainder of the article.

Following out his example the value of e two-thirds of the way down the second column of page 510, is 5.89 volts instead of 16. The value of B is 842, instead of 2300. The commutating ampere turns are 171 instead of 470. The compensating ampere turns remain as before, 2000. The final ratio of auxiliary pole ampere-turns to armature ampere-turns is 1.085 instead of 1.235.

According to the author's formulas (assuming a given number of conductors on the armature), e varies inversely as the number of bars, or, directly as the turns per coil. B is not affected by a change of bars (causing a change of turns).

With the corrected formulas, e varies as the square of the turns per coil and is independent of the number of bars. B varies as the turns per coil and is independent of the number of bars.

The error of the author's formulas is apparent when the number of bars is reduced and increased.

		Author's formulas.			*Corrected formulas.*		
Turns per coil	T	7	21	4	7	21	4
Bars	b	183	61	320	183	61	320
Calculated	e	16	48	9.15	5.89	53	1.93
"	B	2300	2300	2300	842	2526	480
"	KBd	470	470	470	171	515	98
Ratio auxiliary pole to armature		1.235	1.235	1.235	1.085	1.255	1.05

The author has probably found that the high value for the auxiliary pole ampere-turns has given satisfactory results, due, I think, to his established proportions elsewhere. Perhaps his auxiliary pole cross-section is small or he has not allowed for leakage. A larger cross-section might indicate in the performance of the machine that an excess of auxiliary winding is provided.

Ampere, N. J. R. B. Treat.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Voltage Between Segments and Critical Speed of Shunt Motors With Speed Variation Within Wide Limits.—Oelschlaeger.—Most commutator troubles in direct-current machines are due to either too high values of the voltage between segments or too excessive commutation voltage. With respect to the commutation voltage considerable progress has lately been made while little attention has been paid to the voltage between segments. The simple reason is that ordinary machines without special commutation poles are always so designed that the conditions for a proper voltage between the segments are fulfilled. With the new interpole machines, however, there is a danger of getting too high a voltage between segments. This is especially the case for shunt motors which are built for a constant load with a speed varying between very wide limits, the speed regulation being obtained by the insertion of resistances in the field windings. Fig. 1 shows the curves of the fluxes in such a shunt motor at low speed. L_1 is the no-load field flux, A the flux due to the m. m. f. of the armature currents, while the total resulting flux C_1 is obtained by algebraic addition of the two other curves. The ordinates of these curves represent flux density and since the voltage between segments is a function of the flux density and of the speed with which the armature coil cuts the lines of flux, the maximum voltage between the segments will occur at the point D_2. Fig. 2 gives the corresponding curves of fluxes for the same machine, but at high speed. If this high speed is N times the low speed of Fig. 1 then the ordinates of the no-load flux L_2 are 1/nth as large as those of L_1, while the armature flux A is the same since the motor load current has remained constant. The resulting general field is now given by C_2 and its characteristic feature is that a part of it is positive and part of it negative. The maximum voltage between segments is again at a point D_2 but it can be shown by easy calculation that

the voltage between segments is larger in Fig. 2 than in Fig. 1. In other words, the higher the speed the higher the voltage between segments. For the highest speeds which the motor is able to give the voltage between segments may come near the danger limit at which sparking would occur. The author then makes some remarks on the iron losses at high speeds. It would be absolutely wrong to assume that as a result of the extra-

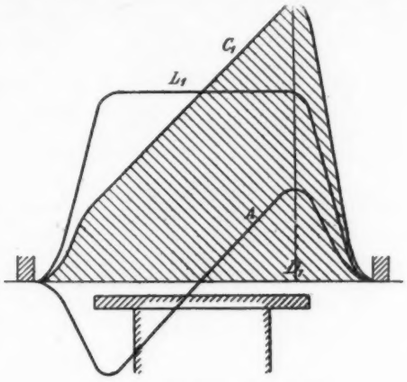


FIG. 1.—CURVES OF FLUXES.

ordinary diminution of the flux L_2 the iron losses would be correspondingly diminished. The iron losses depend on the maximum magnetization of the iron, and Fig. 2 shows at once that even with a very weak field L_2 the maximum magnetization may be quite considerable. The author has made some tests with a motor which was stated to have been designed for 21 hp, and for speeds varying between 200 and 875 r. p. m. The voltage was

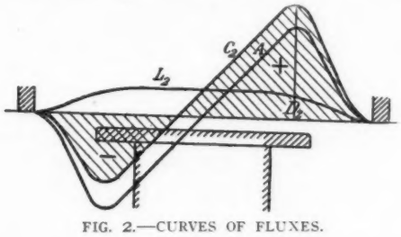


FIG. 2.—CURVES OF FLUXES.

520, so that for six poles and for 254 segments the mean voltage between segments was about 12.3 which is quite moderate. The motor was provided with interpoles and the commutation was good but at the highest speeds sooner or later sparks would form between two segments. Fig. 3 shows the potential curves of this

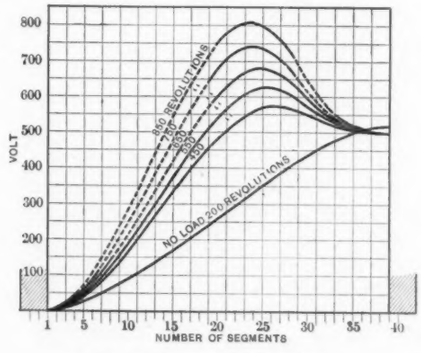


FIG. 3.—POTENTIAL CURVES.

motor. They were plotted in the ordinary way by measuring the voltage between one main brush and another auxiliary brush which was moved along the commutator periphery. These voltages are plotted as a function of the number of segments between the two brushes. Only the drawn-out curves were found by measurement; the dotted portions are extrapolated. From these curves the remarkable fact will be seen that at the higher speeds, there are induced in the armature voltages which are very much higher than the e. m. f. at the terminals. At 850 revolutions the maximum voltage in the motor, measured between main brush and commutator periphery, is 805 volts, so that about 300 volts are produced as "counter-counter-e. m. f." which are added immediately to the voltage at the terminals. Fig. 4 is obtained from Fig. 3 by plotting the differences of the voltage between two segments as ordinates, so that the curve gives the voltages of the segments as a function of the commutator per-

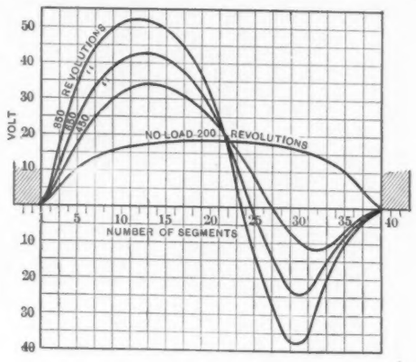


FIG. 4.—VOLTAGES OF SEGMENTS.

iphery. It will be seen that e. m. f.s occur amounting to more than 50 volts between two succeeding segments. This is about four times the so-called mean voltage between segments. This explains the danger of sparking at high speeds, since the highest speeds are too near the critical speed. The curves in Fig. 4 show also the influence of the negative portion of the flux which produces the counter-counter-e. m. f., the production of which is explained in Fig. 2.—*Elek. Zeit.*, March 7.

Magnetic Oscillations in Alternators.—WORRALL.—A paper giving the results of a series of experiments on oscillations of magnetic flux in alternators and their bearing upon the design. The tests were made with a three-phase alternator and the oscillations of flux were measured by means of a number of search coils. The author determined the oscillations on the pole face due to the armature teeth, the oscillations in the interpolar space due to the teeth, the oscillations due to armature reaction, and the penetration into the main magnetic circuit of oscillations due to the teeth and of those due to armature reaction. The author finally discusses the influence of magnetic oscillations on the potential difference wave.—Lond. *Elec.*, February 22.

Power.

Rolling Mills.—BROWN.—An illustrated paper on the application of electric driving to the main rolls in rolling mills. The author shows how the problem may be solved by the use of a motor-generator with a heavy fly-wheel of the Ilgner type which system has been repeatedly noticed in the Digest.—Lond. *Elec.*, February 22.

Smoke Production.—LUCKE.—An article, illustrated by diagrams, on the influence of central station loads on smoke production. Continuous smokeless fluel combustion is impossible with rapid load fluctuations.—*Power*, March.

Shawinigan Falls.—JOHNSON.—A fully illustrated description of the latest developments and extensions of the power station at Shawinigan Falls, Canada.—*Cassier's Mag.*, March.

Traction.

Choice of Frequency.—SCOTT.—A note on the choice of frequency in connection with alternating-current traction systems. Aside from trolley circuits and motors there seems little or no reason to favor low frequency. A 15-cycle motor having the same weight as a 25-cycle motor has about 30 to 40 per cent greater output with higher efficiency and power factor. Moreover, the low frequency enables larger outputs to be secured within given dimensions. Hence the capacity as well as the cost is a factor. If the problem is purely a traction problem, 15 cycles is the recommended frequency. If, on the other hand, other features of the situation make it convenient to take current

from a 25-cycle system, then the proper course to pursue is not always obvious. The best frequency in a particular case depends upon the relative importance of the motor equipments and of the other things. In the beginning when the traction element has less relative importance than it may have later there will often appear strong reasons for adopting 25 cycles. In such cases the probability of future extensions and inter-traffic with 15-cycle loads must be taken into account. Fortunately, 15-cycle equipments may be run from a 25-cycle trolley, though with decreased capacity, and 25-cycle equipments may be operated with 15 cycles provided the transformers are designed for the lower frequency. Moreover, 25-cycle motors and transformers can without modification be operated at reduced capacity on 15 cycles if the trolley circuit have about two-thirds the voltage used on 25 cycles. This method may be useful on some occasions as an emergency expedient. Frequency changers may be placed between 25-cycle or 60-cycle and low-frequency circuits. Aside from objections of cost and losses, they have several merits. The transmission may be three-phase, at a uniform and high-power factor and the single-phase, low-frequency current may have an independent voltage control. This would avoid a single-phase fluctuating load with variable power-factor on the three-phase system. Frequency changers need not be placed in all sub-stations. The low-frequency current may be transmitted to transformer sub-stations.—*Elec. Journal,* March.

Control of Tramcars.—A note on a new method for preventing motormen on tramways from starting or stopping too quickly. It gets rid of the disadvantages of watt-hour meters and current recorders, as its working does not depend on the energy consumed or the current used. It consists of a U-tube containing mercury. The inertia of the mercury causes it to rise in one or other limb whenever the car is started or stopped. The amount of this rise depends on the starting acceleration and brake retardation. When the rise exceeds a certain fixed limit, a circuit is closed and a train of numbers put in motion. The number of times a driver has started or stopped too suddenly can thus be determined.—Lond. *Elec.,* March 8.

Motor Cars.—Poschenrieder.—A review of various types of railway cars driven by steam, gasoline, etc., power, with electric transmission.—*Elek. Zeit.,* February 28.

Electricity on Steam Roads.—B. J. Arnold.—His presidential address before the Western Society of Engineers on the progress of electricity on steam roads in 1906.—*Jour. Western Soc. Engineers,* February.

Double-Time Meter for Tramways.—See an abstract below under Units, Measurements and Instruments.

Installations, Systems and Appliances.

London.—Pearson.—A continuation of his serial on electric power supply stations in London. In the present installment the author deals with the system of the St. Pancras Borough Council. It supplies an important industrial area and the motor load is large and growing. The charges for lighting are, on the maximum demand system, 12 cents per kw-hour "for the first hour" and 3 cents per kw-hour afterwards, or a flat rate of 8 cents per kw-hour. No rental is charged for meters on these systems. A consumer may, however, pay 2 cents per kw-hour for all energy consumed in lamps, except between the hours of 4:30 and 8:30 p. m. when 12 cents per kw-hour is charged. In this case the consumer has to pay meter rent. For motor purposes the maximum charge is 2 cents per kw-hour, the discount being based on the consumers load factor. Canvassing and advertising are carried on by this station more vigorously than in any other in London.—Lond. *Elec.,* February 22.

Electro-Physics and Magnetism.

Graphical Representation of the Quantity of Electricity and of the Energy of Alternating Currents.—Kuhn.—Under the supposition that both the current and the e. m. f. have sinusoidal wave forms the author gives the following method for representing graphically the quantity of electricity and the energy of an alternating current in form of portions of circular areas. The frequency is represented by n. The maximum value of the current by I, the maximum value of the e. m. f. E. The time is counted from the moment in which the current is zero and is increasing. The time at which the quantity of electricity and the energy are to be measured is t seconds after the zero point. The diagram of the author is shown in Fig. 5. A circle around C_1 has a radius $r_1 =$ to the square root of the

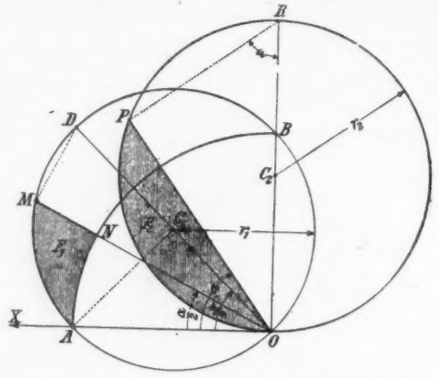


FIG. 5.—DIAGRAM OF ELECTRICAL QUANTITY AND ENERGY.

ratio of I to πn and the angle $n OX$ 45°. If around O another circle is described, the radius being $OA = OB$, and if the angle XOM is made equal to $\pi n t$, the shaded area AMN (indicated as F_1) gives the quantity of electricity. A third circle is described around C_2 with a radius $r_2 =$ to the square root of the ratio of IE to $4 \pi n$ so that the radius C_2O is perpendicular to OX. If the angle POX equals $2\pi n t$, then the shaded area F_2 represents the electrical energy. The quantity of electricity for half a period is the area $AMDBNA$ and the energy in the same time is the area of the whole circle of C_2 with the radius r_2. The above graphical representation of the energy relates to the case that the e. m. f. and current are in phase. If there is a phase difference b, the radius r_2 must be made equal to the square root of the ratio of $IE \cos b$ to $4 \pi n$. —*Elek. Zeit.,* March 7.

A General Problem in Electrical Engineering.—Poincaré.—A mathematical article. The author considers a system which comprises stationary circuits, movable circuits, revolving pieces which receive current through slip rings, but which contains no permanent magnets nor members with commutator or with a variable resistance nor condensers nor any capacity, and which does not receive direct current from the outside. The author shows particularly that such a system, however complicated it may be otherwise, can never constitute a self-exciting generator and that if it receives alternating current from the outside it will always have a phase difference between the e. m. f. and the current.—*L'Eclairage Elec.,* March 2.

Spark Discharges Through a High Vacuum.—Madelung.—An account of experiments on the relation between distance apart of electrodes and the minimum voltage at which sparks appear for very low atmospheric pressures and small distances between electrodes. The higher the vacuum, the more is the relation between distance and voltage represented by a straight line. If the pressure is increased with constant distance between the electrodes, the minimum spark voltage increases, reaches a maximum and then decreases. The smaller the distance between the electrodes the higher is the pressure to which this maximum corresponds. For very high vacuua the dielectric strength is not higher than 40,000 volt per mm if the two electrodes are two globes. If the two electrodes are one point and a plate the minimum spark voltage is very much higher. It is somewhat like 100,000 volts per mm if the point is the negative pole and 140,000 volts per mm when the point is the positive pole. With parallel plates values were obtained which were a little smaller than those for the globes.—*Phys. Zeit.,* February 1.

Transmission of X-rays Through Metallic Sheets.—Adams.—An abstract of a Physical Society paper. For some years after Röntgen's discovery of the X-rays, it was a matter of doubt

whether the absorption of the rays in metallic sheets was accompanied by the development of heat. The author's experimental investigation gave direct evidence of heating developed in a platinum sheet. The transmission of the rays through the sheets was further studied. For instance, the dependence of the absorbing power of a given metallic sheet upon the intensity of the rays incident upon it was examined for sheets of silver. platinum, copper, tin, and aluminum, and in every case it was found that the effectiveness of a sheet as an absorbing medium is independent of the intensity of the incident rays.—*Phys. Rev.*, February.

Alpha Rays.—BRAGG.—An account of the author's continued researches on the relative amounts of ionization produced in various gases and vapors by the alpha particles of RaC. He has determined for several gases the constant which may be called the specific ionization of the gas for alpha radiation, air being taken as the standard. One of his results is that the ionization per molecule is closely connected to the molecular volume.—*Phil. Mag.*, March.

Radioactive Matter in The Earth and Atmosphere.—BLANC.—An account of experiments on the exicted activity obtained by exposing a negatively charged wire to the open air. He found that a great part of the active matter contained in the atmosphere consists of transformation products of radiothorium. The excited activity of the radiothorium type represents generally from 50 to 70 per cent of the total activity exhibited by the wire. The presence of thorium products in the soil and atmosphere is suggested.—*Phil. Mag.*, March.

Fog Chamber.—BARUS.—An article on the efficiency of the plug-cock fog-chamber for the estimation of the number of colloidal nuclei and of the ions in dust-free air.—*Phil. Mag.*, March.

Passage of Electric Waves Through Thin Films.—BLAIR.—An abstract of a Physical Society paper on the change of phase due to the passage of an electric wave through a thin film. This change of phase was found not to be a linear function of the thickness of the film. These results seem to make it necessary to modify the conclusions drawn from previous experimental work upon thin wedges of absorbing media.—*Phys. Rev.*, February.

Ring Discharge.—DAVIS.—A correction of a special point in an older paper of the author on the mathematical theory of the electrodeless ring discharge.—*Phys. Rev.*, February.

Inductance Coefficients.—RUSSELL.—An abstract of a Physical Society paper on the theory of the magnetic field and formulas for the inductance coefficients of circular cylindrical and helical currents.—Lond. *Elec.*, March 1.

Induction Coefficient.—EMDE AND BLONDEL.—Two long mathematical communications on Blondel's formulas for the induction coefficients of straight wires.—*Elek. Zeit.*, February 21.

Electro-Chemistry and Batteries.

Electric Discharge Through Hydrogen and Oxygen.—KIRKBY. The author has formerly studied the chemical effect of passing electricity through a mixture of hydrogen and oxygen gas at low (atmospheric) pressures and between electrodes whose distance apart varied between 0.25 and 1.5 centimeters. The experiments showed that when the circumstances of the discharge were constant, the number of molecules of water was proportional to the quantity of electricity that passed and thus to the number of ions which reached either electrode, and was independent of the size and material of the electrodes. The formula which approximately symbolized the results seemed to indicate that the chemical combination was most intense within the region of the cathode fall of potential, and that it went on to a smaller extent elsewhere, though the discharge was too short to throw this latter effect into relief. The author has now extended his experiments and has found that when the electrodes are widely separated the chemical combination within the positive column may become of equal importance with that within the region of the cathode fall of potential. From the results of his experiments he calculates the amount of chemical action produced by the passage of a coulomb in a centimeter of the positive column when an electric discharge is passed through a mixture of hydrogen and oxygen in equivalent proportions and he also determines the electric forces in the positive column. From his results it follows that when the distance between the electrodes is large the weight of water formed per coulomb passed through the gas is greater for power pressures than for higher ones. Thus the amount of the chemical reaction is by no means proportional to the concentration of the gases; on the contrary the amount of the reaction per coulomb is absolutely increased, and very substantially increased, by diminishing the pressure down to about 1.4 mm provided that the distance between the electrodes exceeds a certain value. When the pressure falls below 1.4 mm the reaction per coulomb becomes less. The pressure of 1.4 mm corresponds to the maximum effect in the author's experiments. The results of the author may be explained by his former hypothesis that the ions, moving swiftly under the electric force, disassociate into uncharged atoms those molecules which they strike—under variable conditions and with sufficiently high velocity, thus set the atoms free to group themselves afresh into molecules of water vapor. On the assumption that the chemical action within the positive column is due to the motion of negative ions, the author estimates the work done in breaking up a molecule of oxygen into its atoms. He finds that it is not greater than 5×12^{-12} ergs. Some of the oxygen atoms dissociated by the colliding ions group themselves into molecules of ozone, but the amount of ozone thus formed is very small.—*Phil. Mag.*, March.

Units, Measurements and Instruments.

Double Time-Meter for Tramways.—WAGMUELLER.—The use of "time meters" for the control of the motormen on trolley cars is said to have proven very successful. (These meters measure the time during which the motors are supplied with current during a trip.) Thus so far only a single meter has been used on each car, but the present author suggests that for cars provided with two motors, two time-meters should be employed, though combined in one instrument. These meters are connected in such a way that one indicates the time during which the meters are connected in series, and the other the time during which they are connected in parallel. The two meters are

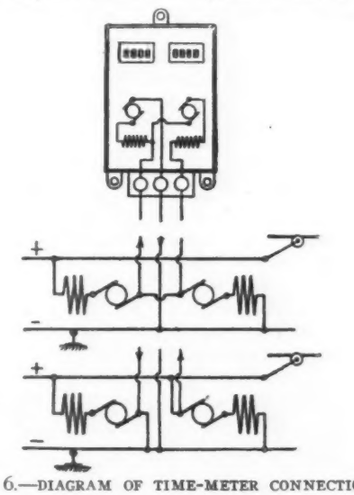


FIG. 6.—DIAGRAM OF TIME-METER CONNECTIONS.

mounted side by side on a common plate. The counting mechanism is driven by a small motor the armature of which rotates in the stray flux of a permanent magnet. Great care has been taken in the design of the brushes. The diagram of the connections is shown in Fig 6. The series resistances are dimensioned in such a way that the first meter gives a reading only when the two motors are in series and the second meter when the two motors are in parallel.—*Elek. Zeit.*, March 7.

Optical Pyrometry.—The conclusion of a fully illustrated summary on this subject. The Holborn-Kurlbaum pyrometer and the Fery thermo-electric telescope are described, and a comparison of the various types is given. Finally some special problems in optical pyrometry are taken up, such as the de-

parture from black body radiation. Finally the latest instrument of Fery is described which combines the principles of total radiation, of optical concentration and of metallic thermal expansion—Lond. *Eng'ing*, March 8.

Telegraphy, Telephony and Signals.

Railway Signalling.—Cadwallader.—A continuation of his illustrated serial on railway signals and the electropneumatic interlocking system. The author describes the pneumatic and electric connections, switches, locks, signals and auxiliary appliances. In an editorial note by Cooper, the underlying reasons of the advantage of combining compressed air with electric devices are pointed out.—*Elec. Journal*, March.

Wireless Telegraph.—The London, Brighton and South Coast Railway has adopted wireless telegraphy for the benefit of its cross channel steamer service. The system used for wireless telegraphy between New Haven and Dieppe is described and fully illustrated.—Lond. *Eng'ing*, March 8.

Wave Detectors.—Tissot.—An article on the use of vacuum tubes as detectors of electromagnetic waves.—Lond. *Elec.*, February 22.

Telegraph Cable.—Mullaly.—The conclusion of his historical account of the laying of the first Atlantic telegraph cable 48 years ago. Now the aggregate length of submerged cables throughout the world is not less than 221,767 miles.—*Jour. Franklin Institute*, March.

BOOK REVIEWS.

Fortschritte in der Anwendung der Rontgenstrahlen. By Dr. Joseph Rosenthal. Munchen: J. F. Lehmann. 31 pages, 20 illustrations. Price, 1.20 marks.

This monograph gives a simple, clear and excellently illustrated description of the more recent developments of X-ray apparatus and its uses. In regard to apparatus, the self-regulating vacuum X-ray tube is described and the electrolytic interrupter. The usual arrangement of X-ray apparatus for hospital and clinical practice is outlined. In regard to applications, the use of X-rays for detecting false diamonds and pearls is very interestingly illustrated. Developments of X-ray applications to surgery and medical diagnosis are discussed at some length. The pamphlet will be of more particular interest to medical men.

Die Gleichstrom Maschine. By Prof. E. Arnold. Vol. I. Theory and Experimental Study. Berlin: Julius Springer. 808 pages, 593 illustrations. Price, 20 marks.

Only a few years ago the theory of direct-current generators and motors was considered simple as compared with that of alternating-current machinery. Commercial considerations have necessitated a more thorough study of direct-current machines in order to economize on the amount of material entering into them. This has resulted in many extensive investigations of commutation and heating and the laws relating thereto. The above work by Prof. Arnold covers a complete investigation of the various factors entering into direct-current machines and explains the theory in a simple manner which will appeal to designers and students of dynamo-electric machinery.

Ban-und Betrieb von Kalte-Maschinenlagen. By C. Heinel. Munich: R. Oldenbourg. 251 pages, illustrated. Price 12 marks.

This work goes thoroughly into the subject of refrigerating machines and the installation thereof and takes up in an interesting manner the driving of these machines by steam and also by electric motors. The application of electric motors to refrigerating machinery is destined to become a much more important factor than in the past, and available information on this subject at present is scarce. The information in this book on European practice is an appreciable addition and will be read with interest. The book also contains tables of standard sizes, speeds, etc., together with efficiencies of the various motors built by the Siemens-Schuckert Werke, which have been apparently copied from their catalogues.

Die Technik des Lastenforderung. By Kammerer. Munich: R. Oldenbourg. 262 pages, 175 illustrations. Price, 12 marks.

The study of hoisting machinery is one that is of great importance and which is not generally studied thoroughly except by specialists. This book first brings out in a very interesting manner the earlier methods employed, making an extensive historical review and after discussing the various applications of steam to hoisting machines, finally goes thoroughly into the matter of the application of electricity to the various forms of hoisting mechanisms and traveling cranes. The most valuable part of the work is that it contains many records of actual accomplishments and gives accurate information as to the details of the various applications. The work will be read with interest by all concerned with the practice, development and application of all classes of hoisting machinery.

Berechnung und Ausführung der Hochspannungs-Fernleitungen. By Carl Fred. Holmboe. Berlin: Julius Springer. 88 pages, 61 illustrations. Price, 3 marks.

This little volume is devoted to alternating-current transmission lines and their behavior from an electrotechnical standpoint. The treatment is mathematical, but at the same time practical, reference being mainly to vector analysis. There are nine chapters dealing respectively with introductory matter, the computation of single-phase mains, the computation of two-phase mains, the computation of three-phase mains, the computation of drop of potential, comparison of conductors required for various systems, the critical voltage, the computation of the most economical voltage, and the practical installation of high-tension conductors, including lightning protection, the prevention of crosses between high-tension and signalling systems and the like.

The treatment is clear and in engineering fashion. The book will be appreciated by all students of alternating current technology.

The Steam-Engine and Other Steam-Motors. The Thermodynamics and the Mechanics of the Engine. Vol I. By Robert C. H. Heck. New York: D. Van Nostrand Company. 391 pages, 190 illustrations. Price, $3.50.

This volume is the first of a series of two intended apparently as advanced text-books for students for the degree of mechanical engineer, although by no means unsuitable for reference purposes for those following the mechanical engineering profession. It takes up the thermodynamics and mechanics of heat engines, more particularly of the reciprocating steam engine, but leaves untouched actual machine design.

Following the natural programme of treatment, the author devotes his first chapter to the theory of the ideal heat engine, using a perfect gas, and then passes to the use of steam as the gas. Subsequent chapters in that section enlarge on the theory of the steam engine, starting with the generation of steam and a discussion of the cycle attainable, passing through the action of the steam in the engine, including, of course, indicater diagram analysis, to the dynamics of steam as utilized in steam-jet apparatus and concluding with a development of the applicability of the entropy-temperature diagram. The second section, on the mechanics of the engine, is exhaustive, containing a full analysis of all the inertia, working and shaking forces and the calculation and application of counterbalances. It is complimentary to Mr. Heck to note that in this may be seen the influence of Prof. Klein, whom the author for some years assisted in the exhaustive study Klein has made of high-speed automatic engine phenomena and design.

The thoroughness of preparation evident throughout and the rational and exhaustive treatment which the subject has received justify looking forward with interest to the second vol-

ume, which is promised and which is to embrace the subject of the form, construction and working of the actual engine and turbine.

Gould Storage Battery Plates.

In designing storage-battery plate proportions, there is a fine balancing between the opposing interests of capacity, requiring maximum surface, and active material condition, renewal and support, requiring substantial ribs and wide intercostal spaces which cut down the available surface. The precise point at which these conflicting demands are best satisfied can be determined only by trial and error; by experimenting with a great number of differently-proportioned plates. In the development of the Gould positives on original lines and by constant observation of many cells in actual use, it has been found that in the plates first put out too much lead had been "spun" into peroxide-forming area, the active material soon filling the narrow .012-inch grooves and bridging over the space between the parallel sided ribs. To correct these defects "V" shaped ribs .05-inch wide at the base, tapering to .008 inch at the end and separated by oppositely tapering "V" shaped grooves of precisely the same dimensions have been substituted for the former .020-inch ribs and .012-inch grooves of rectangular shape.

Blanks of chemically pure No. 17 sheet lead rolled to great density are spun into a ribbed and grooved, girder-like "bridge" structure and brought to a markely increased density by the very process of spinning the parts between rigidly spaced, wedge-like circular formers. The blanks are placed in steel frames and reciprocated between rollers consisting of revolving shafts on which are strung steel disks, separated from one another by alternate washers. The width and shape of the groove depends on the gage and form of the spinning disk, while the width and outlines of the rib are determined by the gage of the washer. The composite rollers are gradually brought together and held up by uniform air pressure against the face of the sheet lead which they form into ribs and grooves, progressively assuming their designed shapes as the knives proceed further into the blank. While the blank is spun into by the disks, no lead is cut away. The lead yields to the pressure and by "cold flowing" rises up into ribs between the forming disks. No lead is removed. It is pressed, burnished and spun into shape. A small unspun portion is left at each end. This unchanged bridge anchors the ribs in place. On large plates, by rolling the plate in four or more sections, a number of transverse vertical and horizontal unspun portions are left, forming strengthening bars of solid conducting material.

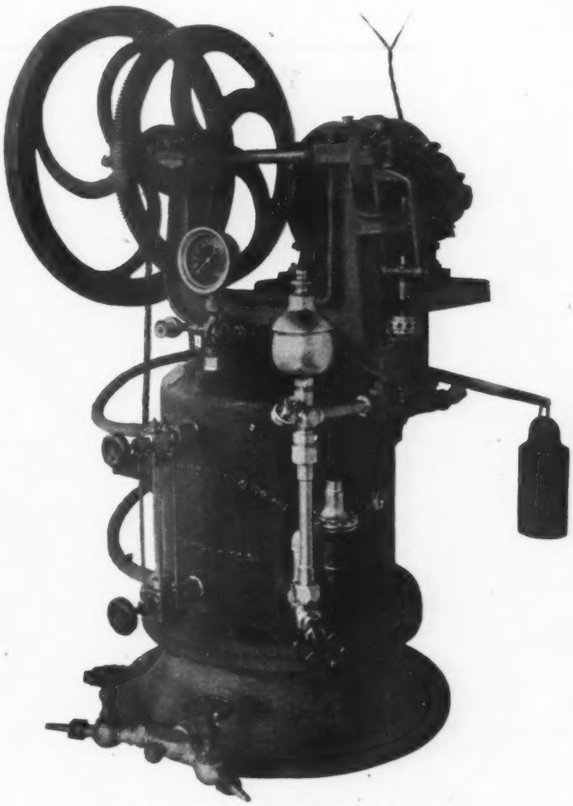
By this process all the advantages of minute and extensive subdivision are secured without sacrificing the mechanical integrity and electrical uniformity of an integral, one-piece plate. At the same time the design enables the charge to be evenly distributed over all while the large masses of unspun strengthening bridges ensure unobstructed and uniform delivery of the current from all parts of the grid on discharge. By electro-chemical action active material is caused to sprout from each rib-face as a matrix, forming with its underlying surface a contact as intimate as that of a branch growing out of a tree trunk. When completely formed the plate is about .45 in. thick.

The "V" shape of grooves and ribs makes an ideal distribution of metal, with active area and metal retaining spaces. When swelling by sulphatation the active material finds a natural, easy outlet for expansion along the prescribed lines of least resistance, while the broad surface at the mouth of each groove forms an excellent retaining or adhering base for preventing loss by dropping off of material temporarily in excess. This construction also disposes the greatest amount of lead in the rib at its base strengthening its connection with the supporting parts while reducing the ohmic resistance between ribs and the grid-skeleton.

So many advantages were found in practice in this design that the Gould negatives are made in the same way. They are smaller in area because the electrolytic action is not as intense as it is on the positives, and because the spongy lead can be kept much thinner than the peroxide. It has been demonstrated that the thinner the layer of active material on the sponge lead electrodes, the greater is the capacity for a given weight of element. To counteract the shrinkage characteristic of all negative active material, the Gould negatives are now formed with 100% above their rated capacity at the three-hour rate of discharge in order to supply enough initial excess of capacity to discount the inevitable shrinkage so that at the end of many years they will not have fallen below their rated capacity. When the shrinkage has reduced the plates below this point, they may be reversed whereby the active material is revitalized and reunited to the support plate, bringing the grid back to its original capacity of double the rating.

Single-Phase Motor-Driven Carbonator.

An application of small electric motors which is finding very extensive use in drug stores is illustrated in the accompanying engraving. This is a ½-hp Wagner single-phase motor driving a carbonator made by the Liquid Carbonic Company, of Chicago. The function of this piece of apparatus is to mix water and carbonic acid gas under pressure to give the carbonated water used in soda fountains. The water is pumped in by the



AUTOMATIC MOTOR-DRIVEN CARBONATOR.

small pump seen at the right, which is driven from a shaft provided with a heavy fly-wheel. The same shaft drives an agitating paddle operated by the sprocket chain.

The water is kept at a constant height by an automatic switch, which starts the motor whenever the water falls below a certain level. The whole apparatus is therefore entirely automatic. The carbonic acid gas is, of course, supplied under pressure from steel bottles furnished by the manufacturers of such gas and connected to the carbonator through a reducing valve. This is a motor application which should be found in every drug store.

Ajax "Jumbo" Mast-Arms.

While originally used only in the East, mast-arms have lately become popular also in the West, as they save extra piles and more rigid support to the lamp than can be had with the swaying cross-suspension method. Finding the usual 12-ft. and 14-ft. lengths too short for many streets, the Ajax Line Material Company, of Chicago, is putting out a "Jumbo" type, built

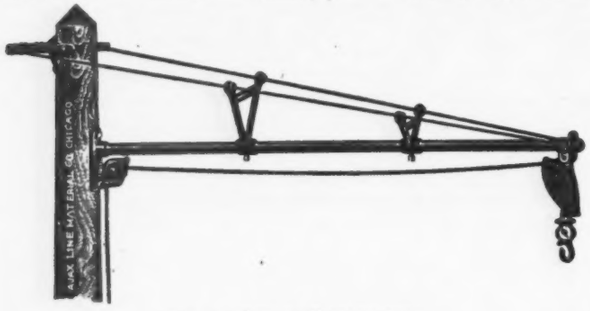


FIG. 1.—"JUMBO" MAST-ARM.

along the same lines as the mast-arms originally designed by Mr. Scheible some years ago.

As the cuts show, this longer type has the outer end supported by strain rods fastened to an "anchored arm" which is bolted to the back of the pole. The latter has side-braces to anchor it to the sides of the pole; there being a double adjustment for the anchoring braces so as to utilize the full

FIG. 2.—ANCHORED ARM.

diameter of the pole. These braces prevent effectively the fixture from swinging, and the pair of triangular stiffeners keep the pipe from sagging, so as to make the whole mast-arm unusually rigid. A safety pulley at the outer end and a companion pulley fastened to the pole-plate complete the Ajax "Jumbo" mast-arm, which is built in lengths from 14 ft. to 20 ft.

Electrical Development in Southern California.

The Los Angeles Interurban Railway Company is one of five or six transportation companies forming what is known as the "Huntington Street Railway & Interurban System" in the Los Angeles District. This company and its associate companies have been undergoing rapid growth and extensions. The Huntington roads ramify Los Angeles County and counties contiguous to it. Their power is taken from sub-stations distributed over the territory described. The number and capacity of these stations is constantly being increased. The motor-generators, etc., installed in these sub-stations which were sufficiently large eighteen months or two years ago are now being replaced by larger and more powerful machines, while the displaced smaller units are pushed further out on the lines.

Three Allis-Chalmers 1000-kw induction motor-generator sets, whose generators have a rated capacity of 1000 kw and motors 1500 kw, have recently been ordered to take the place of some motor-generator sets of smaller capacity, which are to be located at a more advantageous point on the line. In the course of time, if the traffic warrants, the sub-stations which are now being equipped will either be increased in capacity by the addition of more 1000 kw units or these machines will in their turn be pushed further out and replaced by still larger units.

It is interesting to note that the energy for the Huntington roads is taken from at least eight separate generating stations, both steam and water driven, all focusing in Los Angeles and being separated, in some cases, approximately 200 miles from each other. All of these stations work in synchronism.

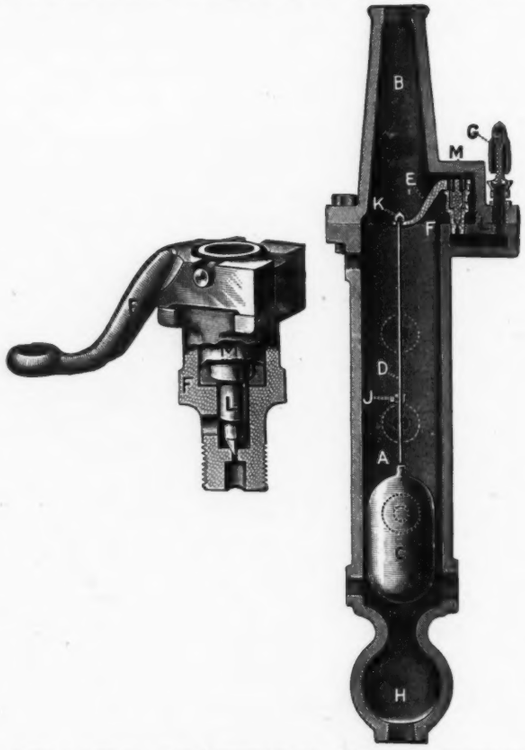
The original power house for the system, which has been added to repeatedly in the growth of the enterprise, will doubtless be operated in the course of time as an auxiliary station. Among other units there are already installed in it three Allis-Chalmers 1500 kw, 120 r. p. m., 50-cycle, 2300-volt engine type generators, all driven by cross compound engines and constituting the latest addition to the equipment.

What was formerly known as the Los Angeles Traction Company was purchased several months ago by the Huntington interests. The entire electrical equipment for this company was built by the Allis-Chalmers Company and comprises an 800 kw., three-phase, engine-type generator, several synchronous motor-generator sets, with raising and lowering transformers and switchboard equipment.

For the Kern River Company, the Allis-Chalmers Company has installed on the Kern River at Caliente, five 3000 kw water-wheel type generators. This electrical energy is transmitted 120 miles to Los Angeles, and a large proportion of the total output from this station is sold to the Huntington roads. The Kern River Company is owned or controlled by the Pacific Light & Power Company, Los Angeles, who is a heavy user of Allis-Chalmers electrical apparatus also.

Safety Water Columns.

The water column illustrated herewith is so constructed that an alarm is sounded automatically when the water in the boiler approaches the low or high danger limit. Attached to the float is a rod which operates through a hole in the whistle valve lever.



FIGS. 1 AND 2.—VALVE MECHANISM AND OPERATING FLOAT.

The rod carries upper and lower stops; the former pulls the valve lever down when the water is too low, while the latter pushes the valve up when the water is too high. In either event steam is admitted to the alarm whistle. This device is manufactured by the Lunkenheimer Company, Cincinnati, Ohio.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Business has responded to the influence of spring weather at most points. Transportation is more satisfactory, but at many cities there are still complaints that seasonable goods do not come forward as specified. One of the best features is the steady improvement in mercantile payments, despite the unsettled condition of the money market. The movement of building materials is heavy, while at many cities real estate is still advancing. Railway gross earnings thus far reported for March exceed those of a year ago by 7.6 per cent, but higher wages and other increased costs of operation have started a movement to advance freight rates. Bank exchanges at New York for the week were 47.2 per cent larger than a year ago, owing, in part, to special syndicate settlements, while at other leading cities the gain averaged 18.7 per cent. General crop conditions are favorable. Excluding Texas, it is thought that the green bug has wrought little damage. However, in the Ohio Valley and Indiana some of the plant has been winter-killed. More activity was displayed in foundry pig iron for future delivery. In the South, where the bulk of the business has been placed, prices have stiffened. While the floods in the Pittsburg district caused only a temporary stoppage of work in the steel and iron industry, the effects thereof were sufficient to retard production. The demand for finished lines continues good, and among the contracts for structural material is 1500 tons for San Francisco. The domestic copper markets were steady and active for all lake, electrolytic and casting copper that could be had up to the time limits fixed by producers. Improving conditions as to fuel and cars are reported from a number of southwestern mines. Conditions at Lake and Rocky Mountain district mines are unchanged. Prices are 26@26½c. for lake; electrolytic, 25½@25¾c.; casting, 25½@26c., 60 days. Manufacturers of copper and brass wares are all employed to the full capacity of works, and are, with a few exceptions, from four to eight weeks behind in deliveries. The unprecedented spring activity in the metal working trades is reflected in the steadily increasing demands for lead, tin, spelter and antimony. *Bradstreet's* reports 157 business failures in the United States during the week ended March 21, against 186 for the previous week and 170 for the corresponding week of 1906.

FOREIGN TRADE.—Good increase was made in the country's foreign trade for February, according to the figures issued by the Department of Commerce and Labor. Imports increased slightly in excess of $19,000,000 and exports were $17,000,000 in excess of the totals for February, 1906. The following table summarizes the total exports and imports for the month as well as the totals for the fiscal year ending Feb. 28 last:

Merchandise:—	1907.	1906.
Imports—Free of duty	$54,990,559	$46,421,006
Dutiable	68,194,650	57,811,873
Total	$123,185,209	$104,232,879
Exports—Domestic	$157,526,143	$139,763,307
Foreign	2,022,503	2,003,201
Total	$159,548,646	$141,766,558
Excess of exports	$36,363,437	$37,533,679
From July 1 to February 28:—		
Merchandise:—		
Imports—Free of duty	$421,486,104	$360,666,539
Dutiable	511,439,281	439,200,981
Total	$932,925,385	$799,957,520
Exports—Domestic	$1,273,076,521	$1,181,517,760
Foreign	16,169,775	16,873,623
Total	$1,289,246,296	$1,198,391,383
Excess of exports	$356,320,911	$398,433,863
Imports	$90,588,040	$38,369,314
Exports	18,575,574	21,190,872
Excess of imports	$81,012,466	$17,178,472

Most of the gain in exports for the month was due to the large shipments of cotton which, as the statement of the export trade in the staple showed, reached unusual proportions.

LARGE AIR BRAKE ORDER.—The Allis-Chalmers Company, Milwaukee, has just secured contract for supplying all of the air brake equipments for all electric railways operated or controlled by the New York, New Haven & Hartford Railroad Company. This is without question one of the most important air brake contracts ever placed, and covers the air brake equipments required by trolley systems in each of the following cities: Port Chester, N. Y., Hartford, Conn., Middletown, Conn., New Britain, Conn., Norwich, Conn., Willimantic; Conn., Waterbury, Conn., Derby, Conn., Milford, Conn., Springfield, Mass., Worcester, Mass., Palmer, Mass., Southbridge, Mass., Pawtucket, R. I., New Haven, Conn., Bridgeport, Conn., Meriden, Conn., Suffield, Conn., New London, Conn., Putnam, Conn., Stamford, Conn., Norwalk, Conn., Southington, Conn., Pittsfield, Mass.; Webster, Mass., Fitchburg, Mass., Leominster, Mass., Woonsocket, R. I., and Providence, R. I. The railways included operate over a greater number of miles of trackage than any other system of electric railways in the world. The number of cars in service at the present time aggregates a total of about 400. Approximately 1400 of the heavier cars are already equipped with air brakes of various types—over 1000 being of the Christensen type, now manufactured by the Allis-Chalmers Company.

THE H. C. FRICK COKE COMPANY, Pittsburg, a subsidiary company of the United States Steel Corporation, has concluded the purchase of new electrical equipment for four of its different coal mining operations in Pennsylvania. These equipments, which comprise main and sub-station apparatus are intended to drive mining machinery. They include rotary converters, transformers, engine-type generators and switchboard apparatus, all of Allis-Chalmers design. At Collier, Fayette County, a sub-station will be installed with apparatus consisting of a 200-kw rotary converter, three 75-kw oil-filled, self-cooled transformers and switchboard; at York Run, in the main power station, additional switchboard equipment will be installed; at Dearth, Pa., two 200-kw engine-type generators will be added to the present equipment of the power plant, and at Ronco two more 200-kw engine-type generators with suitable switchboard will be added. The main station at Phillips will be supplied with two 100-kw engine-type generators and switchboard.

BRILLIANT ELECTRIC COMPANY.—Mr. E. J. Kulas, the general manager of the Brilliant Electric Company, of Cleveland, Ohio, informs us that the business of the concern has reached such a point that it is unable to wait for its new factory at Conenaut, and has been compelled to give up its general offices in the old factory, so that the space may be available at once for manufacturing purposes. After April 1, therefore, the general offices will be located at 403-4 Electric Building, Cleveland. Ground has been broken meantime at Conenaut, Ohio, where one of the best equipped lamp factories in the country will soon be erected. A building contract has been made with the Moore Engineering Company, of Cleveland, for a $50,000 structure, and about the same amount will be put into equipment.

SECOND-HAND APPARATUS.—A good demand for second-hand electrical machinery, quite a number of repeat orders being received, is reported by Mr. George Bender, 137 Center Street, New York. Among recent sales are the following: One 90-kw generator to the Young Women's Christian Association; two 20-hp motors to the National Lead Company, Atlantic Branch, and one 20-hp to Bradley Branch; one 10-kw dynamo and several motors to the Chrome Steel Works, Chrome, N. J.; one 30-kw dynamo and several motors to the Matteawan Steel & Iron Company, Matteawan, N. J.; one 7½-hp motor to the Coldwell Lawn Mower Company, Newburg, N. Y.

MOTOR-DRIVEN ORE CRUSHERS.—For some time past the Smuggler Union Mining Company, of Telluride, Calif., has been operating a Gates ore breaker driven by an Allis-Chalmers motor in one of its tunnels for the reduction of ore underground to a convenient form for handling before it is lifted to the surface. This device has answered the demands put upon it so adequately that the Smuggler Union Mining Company has very recently ordered an additional crusher, another Gates machine, to be used for the same purpose as the older equipment, and to be driven also by an Allis-Chalmers 20-hp induction motor.

ALLIS-CHALMERS STEAM TURBINE SALES.—The sales of small Allis-Chalmers turbine-alternator units of 500 kw capacity would indicate that the space consideration and other advantages hold in the case of small units as well as the large ones. Two recent sales of 500-kw Allis-Chalmers turbo-generator units reported are one to the Bisbee (Ariz.) Improvement Company with a 15-kw motor generator set for exciter, and one to the Binghamton (N. Y.) Light, Heat & Power Company. The Bisbee unit, which will be used for carrying a power and lighting load, mostly the latter, is a 60-cycle machine, wound for two-phase, 2300 volts. The Binghamton unit, which will be used for lighting purposes, is a 60-cycle machine, wound for three-phase, 2300 volts. A number of 500-kw turbo-generator units have recently been put into operation or are now being erected in several parts of the country. Of two units of this size for Jacksonville, Fla., one is fully erected and in operation and the other is being erected at the present time. A 500-kw unit at the power house of the Western United Gas & Electric Company, of Aurora, Ill., is in regular commercial operation daily, and a 500-kw unit of the Meriden Electric Light Company, of Meriden, Conn., is ready to be put in operation. The following companies have 500-kw Allis-Chalmers steam turbine units either in the shops or being erected: Canton Light, Heat & Power Company, Canton, Ohio; Inter-State Railway Company, Wilmington, Del.; Jamestown Woolen Mills, Jamestown, N. Y.; Savannah Lighting Company, Savannah, Ga.

GROWTH OF EXPORTS.—"Exports of Manufactures from the United States and their Distribution, by Articles and Countries, 1800 to 1906," is the title of a monograph issued by the Bureau of Statistics of the Department of Commerce and Labor. It shows that exports of manufactures from the United States now exceed 700 million dollars per annum and have doubled in value in a single decade. Not only has the exportation of manufactures doubled in a decade, but the share which products of the factory form of the total exports is steadily increasing. In 1880 manufactures formed but 15 per cent of the total exports of domestic products; in 1890 they formed 21 per cent, in 1900 35 per cent, and in 1906 40 per cent. The growth of the manufacturing industry in the United States has occurred chiefly in the last 25 years. Stated in round terms, the census figures of the gross value of manufactures in the United States are: For 1850, 1 billion dollars; 1860, 2 billions; 1870, 4 billions; 1880, 5⅛ billions; 1890, 9⅛ billions; 1900, 13 billions; 1905, 14⅞ billions, the figures for 1905 being exclusive of neighborhood industries and trades included in previous years.

NEW POWER PLANT FOR WASHINGTON.—The United States Government after two years of consideration of plans and equipment has just awarded the contracts for the new central power station, which is now in the course of construction at Washington. It will be a most modest plant, situated about four blocks south of the Capitol in Garfield Park, and will, when completed, furnish heat, light and power for the group of buildings immediately surrounding the Capitol, namely, the Congressional Library, the new Senate and House Office Buildings, and the Capitol itself. The contract finally approved by the last session of Congress calls for 16 600-hp high-pressure Atlas water-tube boilers and four 2000-kw Westinghouse-Parsons turbines, which are to be delivered prior to the first of next year, at which time the plant, it is hoped, will be in actual operation. The order for boilers is the largest ever placed by the Government, and the plant, when completed, will be the largest and most modern of its kind thus operated in the United States. J. G. White & Co. are the consulting engineers.

THE AUTOMATIC ELECTRIC COMPANY announces the closing of a contract for 10,000 additional lines of automatic telephone equipment for the Home Telephone & Telegraph Company, of Los Angeles, Calif. This is for immediate installation in the new Olive Street exchange, and the completion of this exchange will practically mean the elimination of the manual equipment now in use in the present main exchange. Other contracts placed with the company during the first two months of 1907 are: Home Telephone & Telegraph Company, Portland, Ore., 3000 additional lines; Montana Ind. Telephone Company, Butte, Mont., 2000 additional lines; Home Telephone & Telegraph Company, Tacoma, Wash., 1000 additional lines; Rushville Co-Operative Telephone Company, Rushville, Ind., 800 additional lines, and several additions to present automatic exchanges.

BREAK IN COPPER.—On Monday of this week, the official quotation of copper metal on the New York Metal Exchange fell for the first time since last July, when the price went from 18¼ cents to 18⅛ cents before it began the steady rise, which continued ever since until March 25. On Monday all grades of copper were reduced from ¼ to ⅜ cent per pound, bringing the quotations of lake copper, the standard grade, down from 25.37½@25.75 to 25.00@25.50. At the same time the London market made the heaviest recessions in more than two years. Spot copper in that market at the close sold at £101 10s, a decline of £4 10s from the last prices of Friday, and futures closed at £102 17s 6d, a drop of £4 2s 6d. At Monday's prices, copper in the London market was off some £10 per ton from the record high prices reached earlier in the year.

UNION SWITCH & SIGNAL COMPANY.—The Union Switch & Signal Company is improving its plant at Swissvale, which will double its capacity. The management found itself greatly handicapped for room, and as the orders during the last few months have continued to demonstrate the permanency of this increasing business, the directors have purchased 34 acres of land adjoining their plant for the purpose of adding to the shops. When the proposed extensions are completed the company will have 140,000 additional square feet of available floor space for manufacturing purposes. The business of the company increased last year 70 per cent over that of the preceding year, and from present indications the company will do a business this year approximating $10,000,000.

ACKER PROCESS ATTACHED.—Two attachments have been received from Erie County against the Acker Process Company, manufacturers of caustic soda bleaching, at Niagara Falls, one for $23,002, in favor of the Niagara Falls Hydraulic Power & Manufacturing Company, for electrical power and rent, and the other for $879, in favor of the Contact Process Company. The Sheriff served the attachments on seven insurance companies here. The plant of the company at Niagara Falls was destroyed by fire on Feb. 25 last, and was insured for $260,000. The company was incorporated under New Jersey laws on April 1, 1899, with a capital stock of $3,000,000. Marcus Stine, of 111 Broadway, is president.

IN A GLUCOSE PLANT.—The Western Glucose Company has recently purchased new steam and electrical machinery for the equipment of the Roby, Ind., plant. A Corliss cross-compound non-condensing engine will be installed to drive an 800-kw alternating-current generator furnishing power for the plant. Five vertical induction motors, of 75 hp each, will be connected to special apparatus used in the manufacture of glucose; and induction motors will be installed for operating the rest of the machinery in the works. A 50-kw synchronous motor-generator set will carry the lighting load for the plant. All of this apparatus will be built by the Allis-Chalmers Company.

INDUCTION MOTORS IN PLANING MILL.—The Slayton Lumber Company, Belmont Avenue, Chicago, whose planing mill was recently destroyed by fire, has already purchased equipment for the new plant. It includes Allis-Chalmers electrical machinery, generator and induction motors purchased through C. D. Stephens, of Chicago. The generator will be a 225-kw machine of standard type, to carry the load of 15 induction motors ranging in size from 3 to 50 hp, and direct-connected to the planing mill machinery.

MINING LOCOMOTIVES.—According to a statement from Pittsburg, the Westinghouse Electric & Manufacturing Company sold last year 325 electric mining locomotives, an increase of 100 per cent over the sales of the previous year. Since the beginning of 1907, the company has already received orders for 175 of this class of machinery, which would indicate that the output of the works in mining locomotives for the present year will at least double that of last year.

FOREIGN CONTRACTS.—It is announced that the London County Council has awarded a contract to the British Westinghouse Electric & Manufacturing Company, Ltd., for equipment for 300 cars to be operated on the municipal electric traction system. The amount of the contract is £100,950. Advices are also received that the Westinghouse interests are to install electrical equipment in the Carylloma silver mines in Peru.

LONG MONTANA TROLLEY.—New York, Chicago, Helena and Butte capitalists this year are to build an electric line between Helena and Butte, at a cost of $3,000,000, a distance of about 55 miles. The road will cross the main divide of the Rocky Mountains. Electrical energy will be derived from the Missouri River at Helena, where a large plant already exists.

Financial Intelligence.

THE WEEK IN WALL STREET.—The week opened with a good deal of nervousness and a feeling of uncertainty about pending developments. There was a great deal of buying of stocks outright, particularly the dividend-paying kind, in small lots, purchasing orders coming from all parts of the country. Throughout the week the money market was comparatively easy, the renewal rate for call loans having ruled at 4 to 4½ per cent, so that the stock market had little to contend with in connection with money. Some attention has been given to the statements that various railroads contemplate raising their freight rates, but, on the other hand, there are further announcements of a curtailment of expenditures for improvements. As the week progressed the market became less active, with considerable irregularity in the price movements. Trading centered once more in the standard railroad stocks, Union Pacific, Reading, St. Paul, Pennsylvania, together with Amalgamated Copper, furnishing the greater part of the transactions. Electric and traction securities were all weak on a declining market, and with one exception all stocks of this class are lower than at the close of the previous week. American Telephone & Telegraph lost 7¼ points net on the week's business, and American Telegraph & Cable 11¾. Brooklyn Rapid Transit dropped 5⅜ and Interborough-Metropolitan 2 and 3¼ for the common and preferred respectively. Westinghouse advanced ¼ point. The curb market reflected the movements of the stock exchange, the trend being downward and under continued offerings of long stock. Following are the closing quotations of March 26:

NEW YORK.

	—March—			—March—	
	19.	26.		19.	26.
Allis-Chalmers Co....	11	11½	General Electric.....	144	141
Allis-Chalmers Co. pfd.	28	27	Hudson River Tel....	..	..
American Dist. Tel....	28	..	Interborough Met. com.	24½	23¾
American Locomotive..	60	60	Interborough Met. pfd.	59¼	54
Amer. Locomotive pfd.	106	102	Mackay Cos.....	..	66
American Tel. & Cable.	75	75	Mackay Cos. pfd.....	..	65½
American Tel. & Tel..	..	..	Marconi Tel.....	..	..
Brooklyn Rapid Transit	53⅜	49½	Metropolitan St. Ry...	..	..
Electric Boat.....	32	32	N. Y. & N. J. Tel.....	..	..
Electric Boat pfd.....	80	80	Western Union Tel...	81¼	80
Electric Vehicle.....	..	..	Westinghouse com....	150	148
Electric Vehicle pfd...	..	..	Westinghouse pfd.....	..	..

BOSTON.

	—March—			—March—	
	19.	26.		19.	26.
American Tel. & Tel..	120	117	Mass. Elec. Ry. pfd...	63	57
Cumberland Telephone.	..	..	Mexican Telephone....	..	..
Edison Elec. Illum....	215	212	New England Telep...	117	114½
General Electric.....	142	142	Western Tel. & Tel...	6	..
Mass. Elec. Ry.....	17	15⅞	West. Tel. & Tel. pfd..	73	..

PHILADELPHIA.

	—March—			—March—	
	19.	26.		19.	26.
American Railways....	49¼	49	Phila. Electric.....	7⅝	7½
Elec. Co. of America...	9	9⅛	Phila. Rapid Trans....	17¼	15¾
Elec. Storage Battery..	55	51½	Phila. Traction.....	92	91
Elec. Storage Bat. pfd.	..	..			

CHICAGO.

	—March—			—March—	
	19.	26.		19.	26.
Chicago City Ry.....	..	150	National Carbon.....	70	70
Chicago Edison.....	..	..	National Carbon pfd..	*113	*110
Chicago Subway.....	..	..	Union Traction.....	..	..
Chicago Tel. Co.....	..	..	Union Traction pfd....	..	..
Metropolitan Elec. com.	23	23			

*Asked.

REPORT OF THE OTIS ELEVATOR.—The Otis Elevator Company has issued its annual report for the year ended Dec. 31, 1906. The income account compares as follows:

	1906.	1905.	1904.
Net earnings.....	$855,167	$912,938	$891,016
Preferred dividends.....	347,792	339,697	335,970
Balance	$507,375	$573,241	$555,046
Common dividends	191,259	127,006	127,006
Balance	$316,116	$446,235	$428,040
Depreciation	216,116	246,235	228,040
Surplus	$100,000	$200,000	$200,000
Previous surplus	1,600,000	1,400,000	1,200,000
Total surplus.....	$1,700,000	$1,600,000	$1,400,000

The balance after preferred dividends and before charging off depreciation shows an amount equal to 7.9 per cent earned on the common stock. President W. D. Baldwin says: "The volume of business for the past year has been in excess of any previous year, and the outlook for this year is promising. There has been expended for the purchase of real estate, new buildings, equipment (exclusive of repairs and maintenance of plants) and acquisition of outstanding stock of subsidiary companies, the sum of $1,214,420; of which sum $1,020,420 has been paid in cash, and the remainder in stock from the company's treasury. These expenditures have called for large cash disbursements, in addition to the increased requirements (working capital) for carrying to completion your company's contracts. The capacity and condition of your company's plants are to-day such as to not only justify the large expenditures made in the past, but also the expectation that the present shops will be able to take care of the larger volume of business anticipated during this year, and to much greater advantage than heretofore, both in the line of prompt deliveries and reduced cost of production. The increased prices paid for labor and material, together with the increased cost of operation, due to effecting changes and improvements in the plants, and the volume of business done in certain grades of work have tended to reduce the margin of profit over previous years. During the year it was deemed advisable to organize Otis Elevator Companies in Illinois, Pennsylvania, Missouri and Texas, to conduct the business formerly carried on by the company in their respective territories."

DIVIDENDS.—Directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred and the assenting and the non-assenting stocks, payable April 10. Directors of the Rochester Railway Company have declared a regular quarterly dividend of 1¼ per cent on the preferred stock, payable April 1. Directors of the United Traction & Electric Company have declared the regular quarterly dividend of 1¼ per cent, payable April 1. Directors of the Washington Water Power Company have declared the regular quarterly dividend of 1¾ per cent, payable April 1. Directors of the Tri-City Railway & Light Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. Directors of the Providence Telephone Company have declared the regular quarterly dividend of $1 per share, payable April 1. Directors of the Duluth Edison Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 1. The directors of the Detroit United Railways have declared the regular dividend of 1¼ per cent, payable May 1. Directors of the Philadelphia Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable May 1. Directors of the Hall Signal Company have declared the regular annual dividend of 6 per cent and a quarterly dividend of ¼ of 1 per cent on the preferred stock. They also declared the regular quarterly dividend of 1¾ per cent on the common stock. The dividends are payable April 1. Directors of the E. W. Bliss Company have declared the regular quarterly dividend of 2½ per cent on the common and 2 per cent on the preferred stock, payable April 1. Directors of the Consolidated Gas, Electric Light & Power Company, of Baltimore, declared a semi-annual dividend of 3 per cent on the preferred stock and also on prior lien stock, payable April 1.

INTERBOROUGH EARNINGS.—The Interborough Rapid Transit Company's statement of gross earnings, operating expenses, net income and passengers carried during the year ended Dec. 31 last shows an increase of $2,697,881 over the gross earnings of 1905. The actual figure for last year was $20,916,147. Operating expenses increased $548,482 to $8,793,486, and net earnings were $12,122,660, against $9,973,261 in 1905, a gain of $2,149,398. Other income decreased $28,061, leaving the gross income for 1906, $12,706,259. Rental paid the city was $943,825 greater in 1906 than in the previous year, reaching the total of $3,961,991, and taxes increased from $1,288,613 to $1,431,074. Net income after the payment of interest and taxes was $7,443,192, a gain over 1905 of $1,125,050. The surplus left after paying 7 per cent on Manhattan Railway stock was $3,545,192, $1,041,050 greater than in the previous year. In the same time the number of passengers carried has grown from 366,174,479 to 420,302,389, and the operating per cent has decreased from 45.26 to 42.04.

WARREN ELECTRICAL MANUFACTURING COMPANY.—The Warren Electrical Manufacturing Company, of Sandusky, Ohio, has purchased the plant and good will of the Warren Electric Manufacturing Company, of the same city. The officers of the new corporation will be Mr. Willard H. Nason, president, who is also president of the Brilliant Electric Company; Mr. Frank Warren, secretary, who has been secretary of the old Warren Company for a number of years; Mr. Norman L. Hayden, general manager. The last-named was president of the Hayden & Derby Manufacturing Company, New York City, for a term of years, and for the past five years general manager of the N. L. Hayden Manufacturing Company, of Columbus, Ohio. In addition to making alternators, the concern will manufacture a full line of direct and alternating current motors and transformers, etc.

GENERAL NEWS.

Construction News.

GADSDEN, ALA.—The holdings of the Talladega Electric Power Company at Jackson's Shoals, near Talladega, have been sold to the General Electric Company, which owns the Anniston and the Gadsden electric companies. Work will commence on the power plant this summer, which will cost when completed $2,000,000. Electricity will be furnished for power purposes and also for operating a line of suburban cars from Anniston to Gadsden and Talladega.

SELMA, ALA.—F. M. Abbott, head of the Selma Street & Suburban Railroad, has purchased a site on Oakmulgee Creek, 10 miles from the city, upon which to erect a power plant to supply electricity for power and light in the city of Selma and other towns nearby. It is also understood that with the erection of the plant, Col. Abbott will run his lines from the city out to the power station, and thence to Summerfield, 10 miles further.

CLARKSVILLE, ARK.—Preliminary arrangements are being made for the construction of an electric railway from Clarksville to the Spadra coal fields, a distance of eight miles, at a cost of $250,000. George Rosenthal, an official of the St. Louis & Westinghouse Electrical Supply Company, is interested in the project.

FORT SMITH, ARK.—The Council is considering the question of installing a municipal lighting plant at a cost of $12,000.

NASHVILLE, ARK.—The Nashville City Council has rejected the proposition of the Brown-Henderson Improvement & Timber Company to furnish the city with electricity for lighting. The company asked for a franchise for 50 years for an electric lighting system and a contract to furnish the city not less than 10 lamps at a monthly rental of $10 each.

EUREKA, CAL.—H. L. Jackman, of the North Mountain Power Company, states that new water powers have been secured for the company on the main Trinity River, covering a distance of eight miles, and capable of developing 15,000 horse-power. The additional power will be used in this city and in the operation of the mining properties between Eureka and Trinity.

LONG BEACH, CAL.—The Pacific Telephone Company has applied for permission to place its wires in underground conduits in the downtown districts.

LONG BEACH, CAL.—A company has been organized by George W. Hughes, a local capitalist, to build an electric railway through the city to the summit of Signal Hill. The company will soon apply to the Council for a franchise.

LOS ANGELES, CAL.—A franchise has been granted to the Los Angeles Pacific Company to construct and operate a street railway over certain streets and alleys in Los Angeles.

LOS ANGELES, CAL.—The Board of Supervisors has accepted bids for two electric railway franchises. Robert Marsh for $100 was given a franchise on West Pico street. S. L. Briggs was granted a franchise on Vermont, Fourth and Western avenues for $100.

LOS ANGELES, CAL.—Bids will be received by the Board of Public Works until May 6 for furnishing and erecting near Tehachapi, Kern County, for the city of Los Angeles, the necessary boilers, engines, electric generators and motors for delivering 875 kilowatts of electric power to the Los Angeles Cement Works, all equipment to be erected by bidder with exception of electric motors. Horace B. Ferris is secretary.

OCEAN PARK, CAL.—The Board of Directors of the Local Home Telephone Company has called a special meeting to vote on increasing the capital stock from $250,000 to $500,000 and to increase the bonded indebtedness from $150,000 to $500,000, the funds thus raised to be used in expansion and development of the system.

SAN FRANCISCO, CAL.—The City Electric Company, the recently organized Fleishbacher Company, has notified the Board of Public Works of its intention to begin at once putting in a conduit for its wires along Market Street from the Ferry to Twelfth Street. City Engineer Woodward will endeavor to get the company to agree to use a conduit in common with the city on the portion near the Ferry, and thus prevent tearing up of the street.

GUNNISON, COL.—The citizens are contemplating an expenditure of about $100,000 in enlargement and improvements to the light and water works plants during the coming year.

HOLLY, COL.—The Holly Sugar Company has applied to the Town Board for a franchise to install a water works and electric lighting system. The cost of the work is estimated from $25,000 to $30,000.

STEAMBOAT SPRINGS, COL.—The Board of Trustees has decided to sever all business relations with the Steamboat Springs Electric Light Company after the present month and has granted a provisional franchise to a new company to erect poles and string wires through the public alleys. It has also promised to enter into a contract for street lighting. The contract existing between the city and the electric light company has a number of years to run. F. E. Milner, a local banker, is interested in the new company and promises to make a 50 per cent reduction on street lamps and 35 per cent to private consumers.

TRINIDAD, COL.—It is reported that the bondholders of the Las Animas Light, Power & Manufacturing Company, of this city, most of the owners residing in Denver, had applied for a receiver. C. H. Paul is superintendent of the company.

HARTFORD, CONN.—The power stations of the Consolidated Railway at Buckland and Vernon are to be enlarged and more machinery installed.

HARTFORD, CONN.—The Hartford Electric Light Company has decided to abolish its service charge to its patrons. The minimum charge of $1 a month will be discontinued wherever a meter is in use, and the patrons will pay only for the amount of electricity used.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company is planning to extend its electric light service to Ellington during the coming summer.

UNIONVILLE, CONN.—The Legislature has passed the bill allowing the Union Electric Light & Power Company to do business in Avon, Canton and Burlington.

WILMINGTON, DEL.—Authority has been granted to the city by the State Legislature for the issue of bonds to the amount of $800,000 for the improvement and extension of the water supply system and other improvements, including additions to power plant, for which plans are now being made. Development of the water power will follow later. Theodore A. Leisen, is chief engineer of the water department.

WASHINGTON, D. C.—The contract for power plant equipment for the U. S. Department of Agriculture has been awarded to S. Faith & Company, of Philadelphia, Pa., for $73,716. Curtis turbines will be used.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 16, to furnish at the navy yard, New York, N. Y., two sets of wireless telegraph apparatus and two duplicate gas-engine generating sets. Applications for proposals should refer to schedule 573. E. B. Rogers, Paymaster General.

PENSACOLA, FLA.—The building at the Navy Yard, in which were the power house of the department of yards and docks, electric light plant, boiler house, etc., was destroyed by fire on March 21.

ALBANY, GA.—A company is being formed in which Joseph S. Davis and Smith D. Pickett are interested for the purpose of developing the power rights of the Albany Power & Manufacturing Company at Porter Shoals on Flint River, two miles north of Albany, at a cost of about $1,500,000, and it is planned to have the dam and power house completed within two years. About 10,000 horse-power is to be developed. A portion of the power is to be used by the Macon, Americus & Albany Electric Railway.

AMERICUS, GA.—Charles W. Murray, city engineer, writes that the citizens, on March 20, voted to ratify the contract made by City Council with W. A. Dodson and associates to furnish street lamps, pump water for city and construct an electric railway.

AUGUSTA, GA.—The Mayor has appointed Councilmen Kent, Woodruff, Lawrence, Smith and Bothwell as a committee to investigate the cost, etc., of a municipal lighting plant.

COLUMBUS, GA.—The Columbus Power Company has offered to furnish the new industrial school with electric energy for the operation of its machinery for a period of five years free of charge. The company offers to furnish 75 horse-power, which would cost $2,000 per year, making a donation of $10,000. Through oversight this item appeared under Columbus, Ohio, in our issue of March 9.

EASTMAN, GA.—The City Council has passed a resolution to hold an election to vote on the issuing of $30,000 additional bonds for the purpose of enlarging the light and water plants and other improvements.

EDGEWOOD, GA.—The citizens have voted to issue $12,500 in bonds for the installation of an electric light plant. J. B. McCrary & Company, of Atlanta, are the engineers.

SODA SPRINGS, IDAHO.—A new electric lighting plant will be erected here, located near the Woodruff Spring.

FREEPORT, ILL.—C. E. Gregory, of Chicago, Ill., has petitioned for a franchise to establish a lighting plant.

HARVARD, ILL.—The Harvard Light & Power Company has purchased the F. L. Smith Electric Light Company and also the municipal electric light plant, which have been consolidated. The company will build a complete new plant. The officers of the new company are: E. J. Condon, president; G. M. Page, vice-president; W. H. Joyce, secretary and treasurer.

LINCOLN, ILL.—The city railway plant at Lincoln has been sold to W. R. Schott, of Chicago, the reported price being $150,000. Possession will be given April 1. Mr. Schott is said to have purchased the plant for the Illinois Traction Company, now building an interurban line through Lincoln to connect Bloomington and Springfield.

WILMINGTON, ILL.—The Wilmington Light & Power Company has been incorporated with a capital stock of $15,000. The company will reorganize and operate an electric light plant in this place. The old plant is not able to meet the demands made upon it at the present time, and the new company contemplates an expenditure of $15,000 for improvements and new equipment. The officers are: J. H. Ray, president; A. J. McIntyre, treasurer, and J. C. Thompson, secretary.

CRAWFORDSVILLE, IND.—The Municipal Electric Light & Power Company has increased the rate from $60 to $66 per arc lamp per year. The object is to establish a sinking fund to provide for impairments and displacements. The trustees propose the following schedule for commercial use: For the first 50 kw 12½ cents per kw-hour; for 100 kw, 10 cents per kw-hour; for 200 kw, 7 cents per kw-hour, and for all in excess of 350 kw per month 5 cents per kw-hour.

ELKHART, IND.—The Board of Public Works has rejected the bids of the Elkhart Electric Company and of Clark & Trainer, of Chicago, because the purchase clause was not satisfactory. The people insisted that the city shall some time own its own plant, the city having twice voted for municipal ownership.

FORT WAYNE, IND.—Owen Ford, of St. Louis, Mo., is making plans and estimates for the municipal electric lighting plant at a probable cost of $160,000.

GREENFIELD, IND.—The committee appointed by the City Council to investigate the condition of the municipal light plant reports that the engines, machinery and equipment are worn out; that the capacity of the plant is inadequate. The city wishes to erect a new $40,000 plant but cannot secure the money by the sale of bonds because having already reached the debt limit the City Council proposes to ask for bids upon the part of manufacturers of electric light machinery to install a plant, the city making an advance payment and permitting the plant to work out its own indebtedness.

HAMMOND, IND.—The Chicago Telephone Company has set aside $100,000 for the improvement and extension of its service in this county.

MADISON, IND.—The Madison Safe Deposit & Trust Company has been appointed receiver for the Madison Electric Light Company upon petition of a judgment creditor, who alleged that the funds had been diverted from rightful channels and insolvency. This plant is owned by the Western Gas & Improvement Company, of Chicago, Ill., of which W. C. Brown is president.

MICHIGAN CITY, IND.—The Michigan City Gas Company and the Michigan City Electric Light & Power Company have been consolidated under the name of the Michigan Light & Gas Company. C. H. Geist, of Chicago, is president of the new company. The new company will be incorporated with $300,000 capital stock. Extensive improvements will be made in the properties.

PERU, IND.—The Fort Wayne & Wabash Valley Traction Company has submitted a proposition to the City Council to furnish electricity to the city for three cents per kilowatt-hour. The Council is now considering the proposition to spend about $15,000 in repairs to the city electric light plant.

SEYMOUR, IND.—The Jackson County Loan & Trust Company has been appointed receiver for the Seymour Gas and Electric Light Company and has been directed to control and operate it. The plant was under orders to be sold at sheriff's sale on an appraisement of $30,000 to satisfy a judgment, but the holders of the bonds opposed the sale. The plant was purchased five years ago by the Western Gas & Improvement Company, of Chicago, Ill., for $55,000. The new owners expended $20,000 in improvements and bonded it for $110,000.

SULLIVAN, IND.—The Town Board has passed a resolution revoking the franchise of the Sullivan Heat, Power & Light Company, claiming that the company has failed to fulfill its contract with the city. The company has a franchise for ten years dating from Jan. 1, 1902. The board will meet soon to arrange the preliminary steps for advertising for the bids for lighting the city.

COUNCIL BLUFFS, IA.—Israel Lovett & Company have purchased the interests of the Wolfe Lovett Electric Company in this city and will continue the business at the same location.

MT. AYR, IA.—The citizens have voted in favor of a municipal lighting plant.

CHAPMAN, KAN.—The Dickinson County Light & Power Company is installing an electric lighting system in this place which will be in operation in about 60 days. The power house is now being built one mile north of the city. The plant will cost about $5,000.

ELIZABETHTOWN, KY.—Surveys have been completed for the proposed electric railway for the Kentucky Central Railroad Traction Company from West Point to this city, a distance of 22 miles.

LOUISVILLE, KY.—E. H. Abadie Company, of St. Louis, Mo., has secured the contract to place underground all the wires of the Louisville Lighting Company in the district bounded by Broadway, Main, Floyd and Eighth streets. This company also has the contracts for conduit work for the Bell, Cumberland & Home Telephone companies, the Kentucky Lighting Company and the Western Union and Postal Telegraph companies.

SOMERSET, KY.—Local capitalists are contemplating the extension of an electric railway from this city to Burnside. It is said the owners of the Somerset Light, Water & Traction Company are behind the project.

WILLIAMSBURG, KY.—The Williamsburg Home Telephone Company has filed amended articles of incorporation increasing its capital stock from $5,000 to $10,000.

BATON ROUGE, LA.—J. H. Hallett, of Boston, Mass., representing Stone & Webster, is now in the city to make arrangements for rebuilding the electric lighting plant.

KENNEBUNKPORT, ME.—The contract for the construction of the electric railway between York Beach and Kennebunk for the Atlantic Shore Line Railway Company has been placed and work on the construction of the line will commence as soon as the weather will permit. The road will be 18 miles long.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company has closed an agreement with the McCall Ferry Power Company for furnishing electricity from its hydraulic plant on the Susquehanna River when completed. The Consolidated will control all the electric energy transmitted to the territory covered by a radius of 25 miles from the Mount Vernon Place, Baltimore, for lighting and power purposes.

BRUNSWICK, MD.—The Brunswick & Middletown Railroad Company is now having a preliminary survey for an electric railway from Brunswick to Middletown.

HAGERSTOWN, MD.—The officials of the Chambersburg, Greencastle & Waynesboro Railway Company are contemplating extending its electric line from Pen-Mar to the Blue Mountain House. Negotiations are also under way for the extension of the electric lighting system so as to light "the path" leading from the Blue Mountain House to Pen-Mar.

LAUREL, MD.—The Laurel Improvement Association has adopted a resolution to ask the Mayor and the Council to bond the town for the sum, not exceeding $50,000, for an electric light plant and a sewerage system. The improvements contemplated to the electric light plant will cost about $13,500.

SPRINGFIELD, MD.—The managers of the Springfield Hospital for the Insane have decided to advertise for bids for constructing the proposed electric railway from Skyesville to the institution. The proposed road is to be two miles long and the estimated cost is about $100,000. Dr. J. Clement Clark is superintendent of the institution.

BOSTON, MASS.—A contract has been placed by the Stone & Webster Company with the Allis-Chalmers Company for two large direct-current engine type, electric generators. Each machine will have a capacity of 10,000 horse-power and will be used on the new extension of the Boston Elevated Railway Company.

DANVERS, MASS.—At the town meeting held March 18, a committee was chosen to investigate the municipal electric lighting plant and report in print whether the plant is a paying or losing proposition.

DRACUT, MASS.—The Lowell Electric Light Company has commenced work on installing the electric lighting system to replace the gasolene lamps now in use in the town. The company has a contract with the town to furnish 100 lamps of 30 candle-power at $23.25 per lamp per year with an all-night service for a period of five years.

HOLDEN, MASS.—William D. Cheney and Stillman F. Morris have been appointed by the Council as a committee to investigate the question of establishing a municipal lighting plant.

LOWELL, MASS.—The Lowell Electric Light Corporation has taken out a permit for the erection of the new power plant in Perry Street. The estimated cost of the structure is $100,000. It is said that contracts have already been made by the corporation for the expenditure of $400,000, which includes cost of building and machinery. The new building will be 75 feet wide by 108 feet long.

PITTSFIELD, MASS.—The city has entered into a contract with the Pittsfield Electric Company for street lighting for a term of one year. The contract will go into effect April 1, when the moonlight schedule will be replaced by an all-night service. Under the new contract the city will pay $79 per year for each of the 124 arc lamps, and $17.25 each for the 680 incandescent lamps. The contract price for one year is $20,750, making an increase of $3,250 over last year.

PLAINVILLE, MASS.—At a town meeting held recently the Selectmen were instructed to investigate the cost of installing 50 electric street lamps in the town.

ROCKLAND, MASS.—The citizens have voted to extend the electric lighting system along Market Street to the Hanover line.

SPRINGFIELD, MASS.—The United Electric Lighting Company has ordered a 3500-kw steam turbo-generator set for its power house. The order was placed with the Westinghouse Company, of Pittsburg, Pa., and is to be delivered next October.

WESTFIELD, MASS.—The citizens have voted to appropriate $1,200 to install either a gas or electric lighting system in the town house.

CHARLOTTE, MICH.—The Common Council has granted a franchise to George Mindeman and others, the promoters of the Albion-Charlotte interurban line. The road, according to the terms of the franchise, must be under construction within three months and completed within a year. The right of way, with the exception of one or two parcels, has been secured.

CLARE, MICH.—The Consolidated Milling, Lighting & Power Company has taken over the Callam & Cornwell plant. A. J. Doherty is at the head of the new company.

DAVISON, MICH.—The proposition to bond the village for $10,000 to build an electric lighting plant was defeated by a vote of 125 to 64, a two-thirds vote being required. The same proposition carried at a special election held Dec. 18 last, but it was afterward found that the election was illegal, so it had to be held again.

GRAND RAPIDS, MICH.—The Council Committee has decided not to enter into a contract with the Grand Rapids-Muskegon Power Company to supply electricity for operating the municipal electric lighting system until the company procures a franchise from the city.

SAUK RAPIDS, MINN.—It is reported that Jacob Heim is considering the installation of an electric light plant in this place.

LACRECENT, MINN.—The citizens have voted in favor of establishing a plant for street lighting.

MINNEAPOLIS, MINN.—Charles Webster, of Minneapolis and Waucoma, Ia., has decided to petition Council for a franchise to furnish electricity for lighting and power purposes in Minneapolis.

GUNNISON, MISS.—There is reported to be a movement on foot here for an electric light plant.

ROCKFORD, MO.—The Ebenezer Telephone Company has increased its capital stock from $500 to $1,500.

BUTTE, MONT.—F. Augustus Heinze has petitioned the Council for an electric lighting franchise, stating to the Council he will cut the present lighting rate more than 25 per cent.

OMAHA, NEB.—The Omaha Electric Light & Power Company is having plans made for a substation in the northwest part of the city to supply Benson and Dundee.

STANTON, NEB.—Definite steps are being taken to secure a municipal electric lighting plant for the town.

ASHUELOT, N. H.—At a recent town meeting the citizens voted to appropriate $1,000 for lighting the streets by electricity.

PITTSFIELD, N. H.—The citizens of this town are contemplating lighting the streets of the town by electricity. At a town meeting held recently Selectman Potter stated that he was corresponding with a firm who were willing to erect a plant at a cost of $35,000 in the town with 100 25-cp street lamps, provided 1500 lamps can be placed in the residences and places of business here.

WINCHESTER, N. H.—The citizens at a town meeting held recently voted to appropriate $1,000 for lighting the streets of the village by electricity.

TRENTON, N. J.—Surveys have been completed for the extension of the New Jersey & Pennsylvania Traction Company's lines from Princeton to Somerville, a distance of 18 miles.

ALBION, N. Y.—The A. L. Swett Electric Light & Power Company, of Medina has been granted a franchise to furnish electricity for lighting and power purposes in this village. The company agrees to furnish arc lamps at $70 per lamp per year for all-night service, and to furnish lamps free of charge for the village buildings, the Swan Library and the school buildings. The village also requires the company to place its wires underground.

BALLSTON LAKE, N. Y.—The Spier Falls Power Company has applied to the Town Board of Ballston for a 25-year franchise to supply electricity for light and power purposes in the villages of Ballston Lake and Burnt Hills.

BERGEN, N. Y.—B. R. Barringer, proprietor of the electric lighting plant, has refused to continue furnishing electricity for lighting the streets at the present price of $1 per lamp per month. There are fifty-six lamps on the streets and Mr. Barringer demands 50 cents additional per month for each lamp. The Village Board has been authorized to contract with Mr. Barringer to light the streets at $1.50 a lamp per month until the Genesee County Electric Light Power & Gas Company, of Batavia is ready to furnish electricity in the village.

BUFFALO, N. Y.—The Economic Power & Construction Company submitted a proposition to the Aldermen's committee to furnish electricity and steam for heating purposes to the citizens of Buffalo. The prices (all maximum) are as follows: Steam for heating purposes 60 cents per 1000 pounds; electricity for lighting purposes 7½ cents, net, per kw-hour; electricity for power purposes, 2 cents per kw-hour, and a service charge for maximum power called for per month of $1 per kilowatt, or 75 cents for electrical horse-power. The proposition also states that it may require a minimum charge for electricity for lighting and for steam. The franchise asked for is perpetual and no percentages of gross receipts are provided for. The company contemplates an expenditure of $2,500,000 in construction work.

FREEPORT, L. I., N. Y.—The citizens have voted in favor of appropriating $3,000 for extensions to the municipal light plant and to furnish an all-night service on the street lighting system.

ONTARIO, N. Y.—The Sodus Gas & Electric Light Company has been granted a 30-year franchise in this town. C. R. Mills is secretary.

POUGHKEEPSIE, N. Y.—Announcement has been made that J. P. Morgan has purchased of the estate of the late Russell Sage for $400,000 the Poughkeepsie & Eastern Railroad, running between this city and Boston Corners, where it connects with the Harlem division of the New York Central. It is understood that the Poughkeepsie & Eastern road will be electrified.

SENECA FALLS, N. Y.—The Town Board on March 19 granted a franchise to the Niagara, Lockport & Ontario Power Company, of Buffalo.

SHERBURNE, N. Y.—The citizens have voted in favor of issuing $15,000 bonds for the building of a municipal electric lighting plant.

SILVER CREEK, N. Y.—The citizens are considering the proposition of lighting the village by electricity or gas.

VICTOR, N. Y.—At the coming municipal election the citizens of this village will vote on the proposition of installing a system of acetylene gas lighting or electricity. Investigation has been made by the Board of Trustees, and it is stated that the cost of installing acetylene gas would be about $7,000, while the wiring, poles and lamps sufficient to light the place by electricity would be about $9,000, after which electricity would be purchased from the Locke Manufacturing Company's plant or the Rochester & Eastern Railroad Company. Neither company has made the village any definite price regarding the cost of electric energy, beyond an offer to furnish the same if desired.

COLUMBIA, N. C.—The Pacolet Manufacturing Company at Pacolet is contemplating the construction of a power house 60 by 78 ft., with a boiler house 53 by 74 ft.

FAYETTEVILLE, N. C.—Plans are being made for the construction of a power plant for the Fayetteville Railway & Power Company by the James D. Lalor Engineering Company, Munsy Building, Washington, D. C.

TARBORO, N. C.—The Carolina Telephone & Telegraph Company has filed notice of increase of capital stock by the issuing of 1000 shares at $100 per share. W. H. Powell is president.

WASHINGTON, N. C.—The Board of Aldermen has granted a franchise to the Washington Investment Company to construct and operate an electric railway through the principal streets of the city.

BELLEVUE, OHIO.—The Bellevue Home Telephone Company has increased its capital stock from $10,000 to $100,000.

CANTON, OHIO.—The Central Heating & Lighting Company has increased its capital stock from $1,000 to $500,000.

COLUMBUS, OHIO.—At the annual meeting to the held April 8 at Camden, N. J., the stockholders of the Columbus Public Service Company will consider a proposition to increase the capital stock of the company by $250,000. The company wishes to extend both the light and power lines and the hot water heating mains.

COLUMBUS, OHIO.—Contracts will soon be let for the extension of the Columbus & Lake Michigan Railway from Lima to Bellefontaine. The road is now operated by steam and is owned by the same interests which control the Indiana, Columbus & Eastern Traction Company.

DAYTON, OHIO.—The stockholders of the Home Telephone, of Dayton, Ohio, are contemplating increasing its capital stock from $1,200,000 to $2,000,000.

EAST CLEVELAND, OHIO.—The Council of East Cleveland has refused to grant a franchise to the Cleveland Electric Illuminating Company to lay a conduit through the village. The Council wanted the company to agree to remove all the overhead wires within a definite period, which the company refused to do.

FINDLAY, OHIO.—The County Commissioners have given the Findlay Forest & Marion Electric Light Company the right of way through the southwestern part of this county for an electric railway which, when built, will connect Findlay and Marion.

LAKEWOOD, OHIO.—The Village Council has granted the Cleveland Illuminating Company a franchise to light the village. The local municipal plant was sold some time ago to this company on condition that it be granted a franchise for lighting the town. The price to be paid for the plant is $76,000.

LATONIA, OHIO.—J. A. Allen, of New York, N. Y., has made application to the City Council for a franchise to construct and operate an electric railway through this city.

OLD FORT, OHIO.—The Old Fort Mutual Company has purchased the plant and system of the Home Telephone Company, of Goldsburg.

TOLEDO, OHIO.—The city has granted the Toledo Railways & Light Company a permit to lay conduits in Monroe Street from Summit to Tenth Street for its high tension wires.

WESTERVILLE, OHIO.—C. P. Sprague, village clerk, will receive sealed bids until April 15 for bonds aggregating $3,000, the proceeds of which are to be used in enlarging and improving the municipal electric light plant of the village.

XENIA, OHIO.—Evelyn Bard, of Chicago, Ill., a bondholder of the People's Gas & Electric Light Company, of Xenia, a corporation capitalized at $175,000 and controlled by the Western Gas & Electric Light Investment Company, a South Dakota corporation with offices in Chicago, has asked for a receiver for the company in the United States Circuit Court. It is charged that the company has been mismanaged and that through failure to pay taxes there is danger of the plant being sold for taxes and of losing franchise rights.

XENIA, OHIO.—Judge Thompson of the Federal Court has appointed the Union Savings & Trust Company of Cincinnati as receiver for the People's Gas & Electric Light Company and has issued a restraining order to prevent any interference with the receiver's management.

CORDELL, OKLA.—The citizens have voted in favor of issuing $20,000 in bonds for the establishment of a lighting system.

ASTORIA, ORE.—E. B. McFarland and S. D. Adair have applied to the City Council for a 30-year franchise for an electric railway starting in this city, thence across Young's Bay to Warrenton and to Seaside.

ECHO, ORE.—The Council is considering the question of constructing an electric lighting plant for furnishing electricity for lighting the streets, business buildings and residences of the city.

MEDFORD, ORE.—The Commercial Club has under consideration the construction of an electric railway system connecting Medford, Ashland, Jacksonville and Central Point with the Medford coal mines.

ONTARIO, ORE.—Henry Hewitt, Jr., of Tacoma, and Seymour H. Bell, of Coos Bay, have closed a deal with the Idaho-Oregon Light & Power Company for the sale of the water works and electric light plant at Ontario, Oregon, and Meridian, Idaho. The consideration was $90,000. The purchasers, who were represented by Mainland Brothers, of Oshkosh, Wis., are the capitalists behind the Ox Bow Bend power plant on the Snake River, about 50 miles below Huntington. The new owners also contemplate the construction of an electric railway along the Snake River in eastern Oregon and southwestern Idaho.

PORTLAND, ORE.—F. C. Finkle, consulting engineer of the Mount Hood Railway & Power Company, from Los Angeles, Cal., is now in the city to prepare plans and specifications for the two power plants projected on the upper Sandy River. Bids will soon be asked for on the electrical equipment for the plants. The first plant will cost $1,000,000 and will have a capacity of 25,000 hp with the initial installment. The plants and the distributing systems will cost between $4,000,000 and $5,000,000, while the railroad to the summit of the Cascades will entail an expenditure of $1,500,000. E. P. Clark, president of the Los Angeles & Pacific Railway Company, is at the head of the company.

BERLIN, PA.—The Borough Council has granted a franchise to the Pennsylvania & Maryland Street Railway Company, which proposes to build an electric railway through the town to Somerset.

CHESTER, PA.—The Philadelphia & Garrettford Street Railway Company has decided to continue its line to Collindale.

LANCASTER, PA.—The Lancaster Electric Light, Heat & Power Company has recently purchased a 650-kw Allis-Chalmers water wheel type alternator for its plant.

LEWISTON, PA.—The Lewiston Electric Light, Heat & Power Company is considering the installation of a 600-kw, 2-phase, 60-cycle, 2300-volt, direct connected unit, a compound condensing Corliss engine, horizontal tandem type. E. F. McCabe is manager.

McKEESPORT, PA.—The Highland Grove Traction Company will extend its lines from North McKeesport to East Pittsburg this summer. S. M. Bowman is treasurer.

NAZARETH, PA.—The Nazareth Electric Light & Power Company has recently installed a series alternating-current street lighting system for 50 lamps. J. A. Miner is manager.

RED LION, PA.—A franchise has been granted to the Red River & Airville Traction Company to operate an electric railway in this place. It is said that the Westinghouse Electric & Manufacturing Company is making plans for the electrical construction and equipment of the road. Electricity for operating the road will be obtained from the McCall Ferry plant. Hugh Ross is president of the company.

ROCKWOOD, PA.—The Rockwood Electric Light Company is contemplating the installation of a new 100-kw unit in its plant. Charles J. Henninger is manager.

SCRANTON, PA.—President Henry Doherty, of the American Gas & Electric Company, has officially announced the purchase of the holdings of the Surburban Electric Light Company, of Scranton.

SCRANTON, PA.—The Scranton Railway Company has purchased an 800-hp engine which will soon be placed in its power house. The company is planning to double track its south side lines.

SUNBURY, PA.—The Edison Electric Illuminating Company is contemplating making extensive additions to its plant this year, but plans have not yet been decided upon. C. J. Callahan is president and manager.

WATSONTOWN, PA.—The citizens are contemplating increasing the incandescent lighting system of the borough electric lighting plant. F. G. Caldwell is manager.

WAYNESBORO, PA.—The Waynesboro Electric Light & Power Company has contracted for a 300-kw, three-phase generator and switchboard changes to adapt same to three-phase operation. John M. Wolff is vice-president and manager.

YORK, PA.—The Edison Electric Lighting Company is considering extending its lines to several towns in the vicinity of York. David Young is manager.

YORK, PA.—The Merchants' Electric Light, Heat & Power Company will soon occupy its new sub-station, where it will also have its offices. The company will at once install a 250-kw generator and in the fall another one will be added. Another large boiler will be added to the power plant in the fall.

PANAMA.—Bids will be received until April 2 by the Isthmian Canal Commission for power plant, pneumatic tools, iron, steel, iron pipe and fittings, valves, anvils, etc. D. W. Ross, Washington, D. C., is general purchasing officer.

CHESTER, S. C.—The Southern Power Company has offered to furnish electricity to the city of Chester provided the city will contract for 1000 horse-power.

LAURENS, S. C.—The City Council has granted a franchise to N. B. Dial to construct and operate a street railway in this city. The franchise is for a term of 50 years.

CHATTANOOGA, TENN.—The Chattanooga Railway Company is considering the construction of a new electric road up Lookout Mountain, for which surveys have already been made.

MIDDLESBORO, TENN.—Prominent coal operators of the Middlesboro district are considering the construction of an electric railway from Middlesboro to Hartranft, a distance of nine miles. Estimates are now being secured for the cost of the work.

NASHVILLE, TENN.—Financial arrangements have been made for the construction and equipment of the Nashville & Columbia Interurban Railway, representing an investment of $1,500,000. Work will soon commence on the construction of the line. H. H. Mayberry, of Franklin, is president of the company.

PARIS, TENN.—The Council has granted a franchise to the Paris Electric Street Car Company over the principal streets of the town. The officers of the company are: John C. Sweeney, president; Y. Q. Caldwell, secretary and treasurer.

BURNET, TEX.—An electric light plant will be installed in this town in the near future.

CLEBURNE, TEX.—Cleburne Gas & Electric Company will increase the capacity of its plant to 500 kilowatts in the early spring. J. D. Oliger is manager.

DALHART, TEX.—The Dalhart Ice & Electric Company will reconstruct its lines at a cost of about $1,000, for which the material has been ordered. W. H. Wolff is manager.

EPHRAIM, TEX.—The municipal electric light plant will establish a day power service about April 1. J. W. Tye is manager.

HILLSBORO, TEX.—The Hillsboro Gas & Electric Company is planning to install a 75-kw alternator and four transformers in its plant during the summer. E. D. Kelly is manager.

HOUSTON, TEX.—The Houston Lighting & Power Company is contemplating extensive improvements and additions to its plant, including the placing of its wires underground and the installation of an additional 1500-kw turbo-generator set, with boilers, condenser, etc. The cost of the machinery alone is estimated at about $150,000. William H. Chapman is manager.

ITASCA, TEX.—A 150-hp boiler will be installed in the electric light plant owned by A. S. Hockaday this spring.

MARSHALL, TEX.—The Arkansas & Texas Consolidated Ice & Coal Company is now installing a three-phase power system. E. L. Wells, Jr., is manager.

PALESTINE, TEX.—The Palestine Electric Light Company will soon install two 300-kw, 60-cycle, 2200-volt Westinghouse Parsons turbo-generator sets, and will discard all other machinery. William Broyles is manager.

SAN SABA, TEX.—The San Saba Light, Ice & Bottling Works Company is now installing meters and will in the near future extend its lines and add new transformers, etc. A 10-ton ice machine with boilers is also being installed in the company's plant. Frank B. Hall is manager.

SEGUIN, TEX.—The City Council is contemplating the purchase of the electric light plant at a cost of $50,000 and making improvements during the first year to cost an additional $10,000.

SHERMAN, TEX.—The Texas Traction Company, which is now constructing interurban lines between Sherman and Dallas, has filed a chattel mortgage and deed of trust in the office of the county clerk covering its prospective line between the two cities named to the Old Colony Trust Company, of Boston, Mass., for the amount of $2,000,000. Provision is also made for issuing $1,000,000 additional bonds for payment of obligations of the Texas Trust Company as they arise and construction of the line and for the purpose of building additional lines.

TEMPLE, TEX.—The Temple Electric Light Company is contemplating installing an engine of 100 horse-power and a 90-kw, 250-volt direct current General Electric dynamo in its plant. F. E. Merrill is manager.

TERRELL, TEX.—The Terrell Electric Light Company has under consideration the installation of an engine of Corliss type. W. C. Drake is manager.

MONTPELIER, VT.—A Westinghouse turbo-generator set of 2000 kilowatts capacity is being installed in the Pioneer plant of the Consolidated Lighting Company.

NEWPORT, VT.—The Newport Electric Light Company will build a 1300-ft penstock from the pulp mill to the present plant and will install new wheels. Charles A. Prouty is manager.

PROCTOR, VT.—The Vermont Marble Company is contemplating installing a 3000-kw, 33,000-volt hydro-electric plant. A. W. Edson is manager.

BEDFORD CITY, VA.—The citizens are contemplating doubling the capacity of the municipal electric lighting plant. C. E. Harris is manager.

MANCHESTER, VA.—Plans are being prepared by E. W. Trafford, of Richmond, for a municipal electric lighting plant. The cost of the proposed plant is estimated at about $25,000.

NORFOLK, VA.—The Norfolk Railway & Light Company is constructing a new power station to furnish electricity to Norfolk, Portsmouth and Berkley. E. C. Hathaway is manager.

ONANCOCK, VA.—The citizens of this place and Olney are considering a proposition to construct an electric railway from Onancock to Olney and from Olney to Wachopreague. B. T. Gunter, Howard K. Powell and James N. Fletcher, Jr., were appointed to secure the charter.

PULASKI, VA.—It is proposed to sell at once $50,000 in bonds for the purpose of constructing a hydro-electric power plant. Address John T. Loving, Mayor.

ABERDEEN, WASH.—The Grays Harbor Light & Power Company is contemplating the construction of a power plant, the main building of which is to be 100x100 ft. The total cost of the plant is estimated at $250,000.

BELLINGHAM, WASH.—Plans are being prepared by the South Bellingham Industrial Club for an interurban railway providing for a route by the way of Tenth street to South Elk street, where connection could be made with the Whatcom County Railway & Light Company's system. Plans will be submitted to Stone & Webster, who will build the interurban line this year.

COLUMBIA CITY, WASH.—The Seattle Electric Company and the Seattle, Renton & Southern Railway have applied to the City Council for additional franchises in this city.

DAVENPORT, WASH.—The Davenport Machine Company is contemplating the development of a water power, starting with 1000 horsepower. William Zinter is manager.

ELLENSBURG, WASH.—A. Nicol, of Yakima, and George Hesse, of Boise, Idaho, have applied to the City Council for a franchise for an electric street railway franchise in this city.

ENTAIT, WASH.—George H. Gray & Son are contemplating enlarging their electric lighting plant. Charles E. Gray is manager.

LEAVENWORTH, WASH.—The Town Council will receive bids until April 23 for an electric light and water franchise. Guy A. Hamilton is town clerk.

MONROE, WASH.—The Monroe Water & Light Company contemplates extending its lighting circuit one and one-half miles and the power circuit one mile. S. H. Buck is manager.

OLYMPIA, WASH.—The Olympia Light & Power Company has under consideration the construction of a large reservoir. L. B. Faulkner is manager.

PORT TOWNSEND, WASH.—The Citizens' Electric Company is considering increasing the capacity of its plant next summer. J. M. Kincaid is manager.

PORT ANGELES, WASH.—The city is about to issue bonds to the amount of $80,000 for the construction of a hydro-electric plant and water works system. The electric plant is to have a capacity of about 300 kilowatts. John Hallahan is manager.

TACOMA, WASH.—Davis Brothers Electric Company, of Tacoma, Wash., has been dissolved, the firm being absorbed by a new corporation, which has just been incorporated with a paid-up capital of $150,000. Marcus C. Davies is president of the corporation.

VANCOUVER, WASH.—The Vancouver Electric Light & Power Company is contemplating the installation of a 400-kw General Electric alternator in its plant. J. R. Harvey is manager.

ELKINS, W. VA.—The Valley Improvement Company is planning to replace its 60-kw generator with a Warren dynamo of 200 kilowatts capacity, also adding a 150-hp boiler, and will later add a 200-kw generator and engine. N. I. Hall is manager.

RIPON, WIS.—The Ripon Telephone Company has filed an amendment to its articles of incorporation increasing its capital stock from $4,000 to $12,000.

STURGEON BAY, WIS.—The Board of Public Works has recommended the purchase of the C. C. Davis property at the foot of Davis Street to be used for the city electric light plant and water works plant.

WALWORTH, WIS.—The Walworth Telephone Exchange Company has increased its capital stock from $4,200 to $7,200.

WEST ALLIS, WIS.—A number of prominent men of this place are working to secure a municipal electric lighting plant for the city.

BATTLEFORD, CAN.—The Council has decided to spend $23,000 on an electric light plant. Address B. Prince, Mayor.

EDMONTON, CAN.—The committee appointed by the City Council to look into the cost of the electric street railway, reports that it will amount to $334,000. Rails have been ordered and construction will be commenced at once. Address City Engineer Keely.

WETASKIWIN, CAN.—The rate-payers have passed a by-law to raise $25,000 for extensions to the electric lighting plant. Address Duncan McEachern, Mayor.

NORTH BATTLEFORD, CAN.—S. Cookson, city secretary-treasurer, writes that bids will probably be called for in May for water works and an electric light plant, to cost about $80,000. Willis Chapman, 103 Bay Street, Toronto, Ont., is engineer.

YORKTON, CAN.—The town has voted to purchase the telephone system and extend it.

WINNIPEG, MAN.—The Manitoba Radial Railroad Company has been incorporated to build electric railways around Winnipeg to the summer resorts.

FREDERICTON, N. B.—Application has been made to the New Brunswick Legislature for an act to amalgamate the New Brunswick Telephone Company and the Central Telephone Company, and also an increase of capital stock from $1,600,000 to $2,000,000. The bill is opposed by the union of municipalities.

FORT ERIE, ONT.—Tenders will be received until April 5 for the installation of an electric lighting system for the village. B. F. Matthews is town clerk.

GUELPH, ONT.—The Hydro-Electric Power Commission has submitted prices for electricity as follows: Five horse-power per day of 10 hours, $33 per annum; 10 horse-power, $31.50; 25 horse-power, $28.50; 50 horse-power, $22.50; 100 horse-power, $24; 200 horse-power, $22.50. The price for a 24-hour day will be slightly higher. According to the schedule arc lamps can be furnished at $45 each, against $65 previously charged.

TORONTO, ONT.—The Council has passed a resolution in favor of the city expropriating the Toronto Electric Light Company's plant.

WOODSTOCK, ONT.—The city is said to be contemplating an extension to the electric light plant. Address the Mayor.

MONTREAL, QUE.—The Dominion Government will install a telephone system along the St. Lawrence River at a cost of $18,000. Address Hon. L. P. Brodeur, minister of railways and canals, Ottawa, Ont.

New Industrial Companies.

THE C. E. BROCK ELECTRICAL COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $20,000. The directors are Charles E. and William A. Brock and Irvin Gelser.

THE BUZZINI EQUIPMENT & CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000. The company will do electrical equipment and construction work. The directors are W. S. Conn, W. J. Buzzini and R. P. Murphy, of New York.

THE BUFFALO AUTO TRUCK & MOTOR COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $150,000. The directors are J. P. Fell, J. L. Erb, C. W. Fell, of Buffalo.

THE CONNECTICUT ELECTRIC EQUIPMENT COMPANY, of Meriden, Conn., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing and selling electrical machinery for telephone, telegraph and other purposes. The incorporators are E. B. Wilcox, A. B. Wilcox and L. T. Fuller, of Meriden, Conn.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 for the purpose of manufacturing electrical appliances. The directors are F. R. Bacon, F. L. Pierce, Milwaukee, Wis.; A. P. Munning, of New York, N. Y.

THE NORWICH ELECTRIC COMPANY, of Norwich, Conn., has filed a certificate of incorporation with the State Secretary. The capital stock is $5,000 and Charles J. Twist, James M. Fillmore and Carroll L. Adams are the incorporators. The new concern will do a general electrical business and deal in electrical supplies.

THE REEVES ENGINE & MACHINE COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $53,000. The incorporators are Andrew C. Reeves, Robert A. Mesler and A. K. Luekle.

THE JAMES F. SHAW & COMPANY has been incorporated at Boston, Mass., with a capital stock of $500,000. The purpose of the company is to construct street railways. The officers are: James F. Shaw, president; George A. Butman, secretary and treasurer.

THE HENRY D. TAYLOR COMPANY, of Worcester, Mass. (electricians), has been incorporated with a capital stock of $4,500 by Henry D. Taylor, Carl H. Page and George A. Gaskell.

THE TWIN-CITY ELECTRIC & CONSTRUCTION COMPANY, of Winston, N. C., has been incorporated with $25,000 authorized capital by E. G. Couch, S. L. Blackburn and A. H. Galloway to do electrical construction and handle supplies.

THE WILKINSON COMPANY, Inc., of New Bedford, Mass. (electricians), has been incorporated with a capital stock of $15,000 by James Wilkinson, Lester C. Billings and H. T. Brown.

New Incorporations.

FRESNO, CAL.—The Sierra Nevada Electric Company, headed by H. E. Huntington, of Los Angeles, and carrying a capital stock of $1,000,000, has been incorporated in this city. The company purposes to supply electricity for lighting and irrigation for the greater portion of San Joaquin Valley. With Mr. Huntington are associated William G. Kerckhoff, A. C. Balch, J. S. Eastwood and Frank H. Short.

LINCOLN, CAL.—Articles of incorporation have been filed for the Lincoln Northern Railway, with a capital stock of $11,200, by E. E. Calvin, William F. Herrin, William Hood, N. T. Smith and J. L. Willcutt.

HEYWORTH, ILL.—The Heyworth Electric Light & Power Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are Charles J. Cramp and others.

WHITE HALL, ILL.—The Prairie State Traction Company has been organized for the purpose of constructing an electric railway connecting White Hall and Gerard and intervening towns. The incorporators are: A. P. Grout, of Winchester; E. S. Greenleaf, of Jacksonville; H. C. Morrow, of White Hall, and others.

AFTON, I. T.—Articles of incorporation have been filed for the Cherokee Power Company with a capital stock of $1,000,000. The company proposes to build a power plant on the Grand River, southeast of Afton. Joseph Snyder, of Joplin, is president. Thomas M. Reynolds, of Afton, secretary.

HENDERSON, KY.—Articles of incorporation have been filed for the Henderson Traction Company with a capital stock of $150,000. The incorporators are: Walter Schmidt, Cincinnati, Ohio; James W. Garrison and Samuel McDonald, of Louisville; C. C. Tennis, of Pittsburg, Pa., and J. H. Lyne, of Henderson.

PORTLAND, ORE.—Articles of incorporation have been filed with the Secretary of State for the Pacific Light & Power Company with a capital stock of $50,000 for the purpose of constructing and operating electric power and water plants, etc., in Portland and throughout the State. The incorporators are C. P. Houston, Junction City, and D. A. Houston, of Portland.

READING, PA.—A charter has been granted to the Manufacturers' Electric Company to supply heat, light and power by electricity; capital, $5,000. Incorporators: M. C. Comber, Philadelphia; F. W. Farrington, Brooklyn, N. Y., and others.

RIDGEWAY, PA.—The Elk Street Railway Company has been chartered to construct a street railway from Johnsonburg to St. Mary's, a distance of 18 miles. The capital stock of the company is $500,000. Surveys have been made and it is expected that work will begin on the construction of the road in the spring. W. S. Ravenscroft is president.

SMITH'S FERRY, PA.—The Woodlawn Electric Street Railway Company has applied for a charter. The new road will extend from Pittsburg & Lake Erie Station at Beaver to New Sheffield. The road will be about six miles in length, and the general offices of the company will be located at Aliquippa. The incorporators are D. G. Duggan, James A. Newell, J. E. Wilson and others.

STRASBURG, PA.—The Strasburg Light, Heat & Power Company has been organized with a capital stock of $50,000. The company intends to add to its present plant at Edisonville the water power at Wheatland Mills and transmit electricity to Quarryville, New Providence and Refton. L. J. Blair is secretary and treasurer.

STROUDSBURG, PA.—The East Stroudsburg Light, Heat & Power Company will soon apply for a charter with a capital stock of $10,000. The promoters are: L. H. Burnett, T. Y. Hoffman, J. A. Singer, J. W. Booth, V. S. Loder, Abraham Albert, H. B. Drake, George W. Fabel, L. S. Hoffman and E. L. Kemp.

YORK, PA.—The York & Hanover Street Railway Company has been chartered with a capital stock of $120,000. The charter provides for the construction of an electric line to 19 miles long. W. F. Bay Stewart is president of the company and the other directors are: George H. Frazier, of Philadelphia; Grier Hersh, of York; David Young, of Newark, N. J.; Thomas Newhall, of Philadelphia, and George S. Schmidt, of York.

CHESTER, S. C.—The Chester Traction Company has been organized with a capital of $50,000 for the purpose of building an electric railway.

RAPID CITY, S. D.—The Dakota Power Company has been granted a charter for the purpose of developing a hydro-electric plant on Rapid Creek to furnish electricity for light and power. L. A. Richards, of Rapid City, is one of the incorporators.

BLUFF CITY, TENN.—The Holston Mining & Manufacturing Company and the Houston Water, Electric & Power Company have made application for charters. The stockholders for the two companies are practically the same, which are as follows: M. L. Fowler, J. G. Haun, E. S. Fraser, E. P. Kinsel and J. H. McCue. The purpose of the company is said to be to develop a water power on the Holston River at Bluff City, Sullivan County, and to generate electricity for lighting and power purposes.

CISCO, TEX.—The Western Light & Power Company has been incorporated with a capital of $50,000. The home office is to be in this city, but establishments will be maintained in Anson, Sweetwater and Rising Star.

MINERAL WELLS, TEX.—The Mineral Wells & Lakewood Park Street Railway Company has been chartered with a capital stock of $25,000. The incorporators are: Cicero Smith, E. E. Dismuke and Marcus M. Bright.

CEDAR CITY, UTAH.—The Cedar City Light & Power Company has been incorporated with $30,000 capital, with George W. Decker, president, and Joshua H. Arthur, secretary.

WINNIPEG, MAN.—The Winnipeg & Northwestern Railroad Company has been incorporated with a capital of $2,000,000, with powers to build an electric railway from Winnipeg to Edmonton and Lac du Biche.

Legal.

LIABILITY OF CORPORATION FOR MONEY BORROWED BY ITS PRESIDENT.—A corporation, having become involved and being in a very critical financial condition, its president undertook to borrow money, representing that the money was to be applied to the use of the corporation. But the president, unfortunately, was even more involved than the corporation, and instead of turning the money over to the corporation he used it as his own. An action was brought against the corporation to recover the money loaned and the defense was that the money was loaned not to the corporation but to its president. It was held that, the president having borrowed the money in the name of the corporation, as he had authority to do, the corporation was liable for the amount borrowed, although it had never derived any benefit from the loan. N. H. Martin & Co. vs. Logan, Court of Appeals of Kentucky, 99 S. W. Rep. 648.

ACTION FOR INFRINGEMENT OF VACUUM TUBE PATENT.—Claim one of the Sayer patent, No. 594,036, for an improvement in vacuum tubes, which covers, "as a means for varying the pressure in a high-vacuum tube, a main circuit for operating the tube and a shunt-circuit for varying the pressure," has been held invalid for the reason that it represents a function merely. A function or result is not patentable; the patent can be obtained only upon the means or art by which the result is effected. But claims following, which were made under the same patent, were held to be valid.

Claim 1. "In combination with a high-vacuum tube, a shunt-circuit arranged in proximity thereto, means connected with the above, and set into operation by the current in the shunt-circuit to cause gas to enter said tube, and means for varying the pressure in the shunt-circuit.

Claim 3. "The combination with a high-vacuum tube of a shunt-circuit arranged in proximity thereto, and means connected with the above, and set into operation by the current in the shunt-circuit to cause gas to enter said tube." Queen & Co. vs. R. Friedlander & Co., U. S. Circuit Court N. D. Ill. E. D., 149 Fed. Rep. 771.

RIGHT OF ELECTRIC POWER COMPANY TO TAKE PROPERTY BY CONDEMNATION.—In order to entitle a private corporation to exercise the exceptional right of eminent domain, the use which forms the basis of its application therefor must be such as will serve the public in some appreciable way. The service which the corporation contemplates giving must be one which the public can demand as of right and not such as may be bestowed by the corporation at its will and pleasure. It is not sufficient that the intended improvement will operate as a benefit to the community by increasing property values or otherwise. But the service must be such as every individual member of the community similarly situated, shall have the right to demand and receive, whether the corporation would accede to the bidding or not. Such a service is that rendered by the Shasta Power, organized "to generate, transmit and furnish electricity and electric current to the public in general, and to all inhabitants and persons within the county of Shasta and elsewhere, in the State of California, for the necessary public use of light, power and heat." And, under the statutes of the State of California, the Shasta Power Company was held to have the power to condemn land for the purpose of constructing ditches, through which to convey water to its power house for the purpose of operating its machinery. Shasta Power Company vs. Walker, U. S. Circuit Court N. D. Cal., 149 Fed. Rep. 568.

LIABILITY OF LIGHTING COMPANY FOR INJURY TO BOY RESULTING FROM CONTACT WITH LIVE WIRE.—In not every case where a small child is injured by coming in contact with a live wire is the owner of the wire liable in damages. One of the rules which limits the liability of electric companies in such cases is that it is for the natural and probable consequences of a negligent act only that the person or corporation accused can be held responsible. In a case which recently came up in Nebraska it was shown that the defendant electric light company owned wires which were strung along the outside of a viaduct at a distance of about thirty inches from the top of the fence which ran along the edge of the viaduct. The plaintiff, a boy twelve years of age, was crossing the viaduct with a number of companions when one of the party remarked that a friend of his had received a shock a few days before from one of the wires which he pointed out. The plaintiff then proposed that he would climb upon the fence "and see if he could get a shock." All the other lads warned him against so doing, but he persisted, telling them to stand at one side, so that if, when he should touch the wire, he should fall, he would not hurt them. After making a second attempt he succeeded in touching the wire and received the injuries for which he sought to recover damages. It did not appear that the defendant's structure was unskillfully or negligently made or that it differed in any respect from such as were required by the authorities of the city of Omaha wherein the accident occurred. The wires were not within the public roadway and it was held that negligence could not be presumed from the fact that they were not insulated. The plaintiff showed a somewhat remarkable persistence in the pursuit of known danger and seemed to have fully anticipated and appreciated what would probably happen upon his touching the wire. Under the circumstances the company was held to be free from liability, the injury to the plaintiff being regarded as one which the company could not reasonably have been expected to foresee. Johnston vs. New Omaha Thomson-Houston Electric Light Company, Supreme Court of Nebraska, 110 N. W. Rep. 711.

ASSESSMENT ON STOCK.—Advices from Cleveland, Ohio, of March 22 state that the prominent Cleveland men who, it was charged, issued to themselves as paid up stock $2,990,000 of the capital stock of the Miami & Erie Transportation Company, must come to Cincinnati to defend a suit to assess them for the liabilities of the corporation. Such is the conclusion of a report filed in the Federal Court by Thornton M. Hinkle, as special Master Commissioner. Rudolph Kleybolte, as a bondholder, brought the suit. The defendants contended that there was a suit filed in Cleveland raising the same questions and having prior jurisdiction to the Kleybolte suit. To settle this contention, Mr. Hinkle was designated as a special master. He sustains the claim of the attorneys for the Kleybolte interests.

HECKLING BY HEARST.—Mr. W. R. Hearst has filed a petition with Attorney General Jackson asking that legal proceedings be instituted to bring about a dissolution of the Interborough-Metropolitan Company for alleged conspiracy to stifle any competition in transportation facilities. It is charged that Thomas F. Ryan with his associates in the Metropolitan Company, and August Belmont with his associates in the Interborough conspired to deprive this city of adequate transportation facilities, to prevent competition and create a monopoly by consolidation. It is declared that the unlawful purpose intended by those forming the merger has been largely accomplished, inasmuch that during the three months following the merger the Metropolitan system reduced the number of cars operated 5 per cent, while it collected 2.9 per cent more fares. The elevated roads ran fewer cars by 2.9 per cent and collected 7.1 per cent more fares. The subway carried 38.3 per cent more people and added only 12.5 per cent to its facilities. Mr. Hearst made a similar petition to Julius Mayer while the latter was attorney general, but he declined to take any action.

Educational.

RAILWAY ENGINEERING.—Prof. E. C. Schmidt, associate in the department of railway engineering of the University of Illinois, has issued a leaflet circular of information calling attention to the courses in railway engineering and administration. One of these courses deals with railway electrical engineering. There is an electric test car at the university of interurban type equipped with four 50-hp motors and the Westinghouse multiple control system recording ammeters, voltmeters, etc., and the car is run over the lines of the Illinois Traction Company's system.

Personal.

MR. A. H. STANLEY.

MR. ALBERT H. STANLEY, who has just resigned his position as general manager of the railway lines of the Public Service Corporation of New Jersey to accept that of general manager of the Underground Electric Railways Company, Limited, of London, was the guest of honor at a banquet in New York at the Waldorf-Astoria Hotel in the Astor Gallery, March 22. Mr. Stanley expects to leave for London about April 1. The affair was characterized by great cordiality and the desire of all those present to express the high esteem in which they held the guest of the evening and bear tribute to his high ability and strong personality. The tables were arranged in the form of a large circle and were banked with flowers. About one hundred were present, including many of Mr. Stanley's former associates in the Public Service Corporation, representatives from the transportation companies of New York City, Central New York State, Buffalo, Cleveland and elsewhere, together with others prominent in the electrical industry. Mr. C. Loomis Allen, vice-president and general manager of the Oneida Railway Company, the operating company of the New York Central's trolley lines in Central New York State, acted as toastmaster in the unavoidable absence of Thos. N. McCarter, president of the Public Service Corporation. Mr. Allen first read letters of regret from Mr. McCarter and Mr. Vreeland, who were absent through illness, and from a few others who were not able to attend the banquet. He then portrayed the great regard and affection with which Mr. Stanley is held by all the railway men who have become acquainted with him, sketched the services which he has accomplished both for the companies with which he has been connected and the industry at large and extended to him the most cordial wishes of all his friends for success in the new and important work in which he is so soon to become engaged in his native land. The speaker then, in behalf of those present, gave Mr. Stanley a handsome fob and watch as a reminder of his friends and experiences in America. Mr. Stanley responded later in an appropriate and graceful manner amid great applause. Col. Sterling, of the Public Service Corporation, followed Mr. Allen. Among others who spoke were Messrs. Frank Bergen and Howard MacSherry, of the legal department of the Public Service Corporation, who represented Mr. Stanley's associates in the operating department of that company; James H. McGraw of the *Street Railway Journal*, who spoke as the representative of the technical press, and Charles G. Castle and Daniel M. Brady, who represented the manufacturers.

MR. H. H. VREELAND has been elected a director of the Electric Storage Battery Company of America, to succeed Mr. T. F. Ryan.

MR. S. EDWARDS, of Calgary, Alb., formerly superintendent of the Canadian Pacific Railroad's telegraphs, has been appointed manager of the Alberta Government long distance telephone system.

MR. J. H. LUKACH, vice-president of the French Westinghouse Company, has been visiting this country on important business and has now returned to Paris. The company has recently closed some important railway contracts.

MR. FRED CLEAVER, manager of the Iowa Telephone Company at Iowa Falls, has been appointed superintendent of the Iowa Telephone Company at Dubuque, Ia. Mr. Cleaver is in full charge of affairs and is being given hearty welcome by his many friends in the city.

MR. H. J. COX has succeeded Mr. J. H. Porter as the general agent of the Wilmington City Electric Company, of Wilmington, Del. Mr. Cox was formerly general agent of the Suburban Electric Company, of Scranton, Pa., and prior to that was engaged in similar work in St. Louis.

MR. F. W. CASLER, who has been superintendent of the Manchester Street power station of the Rhode Island Company, Providence, R. I., since it was built, has severed his connection with the company and will go to Boston, Mass., where he will take charge of the Lincoln Street wharf power station.

MR. LOUIS D. HESS has been selected as superintendent of the Citizens' Electric Light Company, of Altoona, Pa. He has been for a number of years connected with the telegraph department of the Pennsylvania Railroad at the Altoona shops, and has many qualifications for his new position. He was at one time captain of the Altoona football team.

MR. LUDWIG AMSON, associate A. I. E. E., and Mr. Philip Leserman, Jr., M. E., the former being connected with the Marconi Company as construction manager, the latter as consulting engineer, have gone into partnership under the name of Power Engineering & Contracting Company, for a general engineering and contracting business, with offices at 1123 Broadway, New York City.

MR. RALPH D. MERSHON was entertained March 8 at the Hotel Ritz, Paris, by the Marquis of Winchester, director of the Victoria Falls Power Company. Mr. Mershon was in Europe to attend meetings of a commission which he and Prof. Blondel are members to study the question of high-voltage transmission in connection with the proposed Zambesi Falls-Rand 700-mile power transmission scheme.

SIR W. H. PREECE, F. R. S., who has not visited this country for several years, is due to arrive from Liverpool on the "Caronia" on April 2 and will stay at the Hotel Belmont while in New York. He is to attend the opening exercises of the Pittsburg Institute, as a guest of Mr. Carnegie, on April 11, and will also participate in the dedication exercises of the new Engineering Societies Building in this city on April 16 and 17.

MR. M. INOUYE, manager of the Kwansai Railway Company, Japan, is on a visit to the United States to look into the subject of electrification of steam railroads. He is accompanied while in this country by Prof. Ogura, of the University of Kyoto. Mr. Inouye will return to Japan by way of the United States after visiting Europe. The Kwansai line is at present equipped with steam locomotives, but the matter of changing to electric traction is now under consideration.

MR. EGBERT DOUGLAS, formerly of Schenectady, and at present electrical engineer for the Cataract Power & Conduit Company, will leave Buffalo on April 1 to become head of the power selling department of the Electric Bond & Share Company of New York City. Mr. Douglas is still a young man, but he is well known in the electrical world as an expert engineer. He went to Buffalo about four years ago from the General Electric Company at Schenectady. His successor with the Cataract Power & Conduit Company is Mr. August Smith, of the General Electric Company.

MR. J. F. W. BUNSEN has entered the employ of Muralt & Company, engineers and contractors, New York, and will take charge of their southern office in Charleston, S. C. Mr. Bunsen, who is a nephew of the late Prof. Bunsen, the inventor of the burner which bears his name, has had many years' experience in designing and erecting important engineering works. At the time of the Galveston flood Mr. Bunsen was the mechanical superintendent of the American Cotton Company, Southern District, and was delegated by the city of Galveston to prepare the designs and plans for a system of breakwaters; and although his plans were not immediately utilized on account of lack of funds, the present admirable breakwater stystem has been built practically in accordance with his original ideas and plans. His experience also includes the design and erection of various breweries, sugar refineries, spinning mills and electric light and power plants, including oil refineries for the Standard Oil Company in Mexico and South America, cotton mills for the American Cotton Company and various sugar plants in Cuba, Mexico and South America. Mr. Bunsen will have charge of Muralt & Company's various projects in the Southern States, and especially the large power plant which that company is now building for the U. S. Government at the Charleston Navy Yard.

MR. E. M. McILVAIN, formerly president of the Bethlehem Steel Company, has been elected president and general manager of the Robins Conveying Belt Company, Park Row Building, New York.

MR. W. D. STEELE, vice-president of the Benjamin Electric Manufacturing Company, has taken up the active management of its commercial department at the company's headquarters in Chicago. Mr. Steele has for a long time been in close touch with electrical engineering, especially lighting, having served as engineer with the Brush Electric Company, later as city electrician and superintendent of the electric light plant of Detroit. He has also been connected with the New York office of Westinghouse, Church, Kerr & Company for the past seven years.

Trade Publications.

DOMESTIC MACHINERY.—A catalogue recently issued by G. S. Blakeslee & Company, New York, deals with mechanically-driven dish washers, bread crumbers, knife polishers, ice cutters and roll warmers for hotels and restaurants.

GAS ENGINE.—The Bates Machine Company, Joliet, Ill., has issued an illustrated folder, describing gas and gasoline engines for power plants, pumping stations, lighting plants and air compressors.

LINE CONSTRUCTION MATERIAL.—In its catalogue No. 1, the Ajax Line Material Company, 12 South Jefferson Street, Chicago, describes and illustrates a complete line of well designed electric light specialties.

COAL HANDLING MACHINERY.—Numerous illustrations of coal and ash handling machinery installed at various power houses are given in a bulletin recently issued by the Jeffrey Manufacturing Company, Columbus, Ohio.

HIGH-SPEED DRILLS.—An illustrated catalogue and price list, designated as No. 34, has been issued by the Cleveland Twist Drill Company, Cleveland, Ohio, devoted to high-speed drills and giving practical hints concerning the use of such drills.

BOILER SCALE.—An interesting and instructive illustration on boiler scale and its removal is given in a catalogue of the Lagonda Manufacturing Company, Springfield, Ohio, which describes the Wieland mechanical boiler tube cleaner, the Weiland direct motor cleaner and their numerous applications.

VARIABLE SPEED GEAR.—The S. & S. Engineering Company, 581 Park Place, Brooklyn, N. Y., has issued an illustrated bulletin dealing with its mechanical variable-speed gear. The gear allows the speed to be changed in the ratio of 4 to 1 by the use of expansion pulleys. The device is available for from 2 to 128 horse-power.

STEEL VENTILATING FANS.—Bulletin No. 1418 of the Allis-Chalmers Company is devoted to its steel ventilating fans, which are made at the Scranton works. One or two of the largest, engine driven, are shown in the illustrations. There is also an engraving that shows the application of the induction motor to such work.

ELECTRIC BLOWERS.—In its catalogue, No. 104, the Green Fuel Economizer Company, Matteawan, N. Y., illustrates and describes fans, blowers and exhausters for all purposes, including planing mill exhausters. The catalogue contains also an account of certain improvements recently made in fan construction, together with engineering information and tables.

THE HORSE.—A very clever brochure entitled "The Horse," has been issued by the Joseph Dixon Crucible Company, of Jersey City, N. J. It is really an epitome of horse knowledge and "horsey" language, but the point is cleverly made that Dixon's graphite axle grease is the best thing in the world to use in order to lessen the load on the beast of burden and of sport.

Business Notes.

THE WESTERN WIRE SALES COMPANY has taken over the business, good-will, assets, agencies, etc., of J. Allen Haines (Incorporated), 324 Dearborn street, Chicago. The company is publishing a weekly market letter sent to all desiring it, which gives information on the copper market and new devices.

ALLIS-CHALMERS COMPANY has issued a card announcing that it has opened a new branch office at 316 Godchaux Building, New Orleans, La., where all business in the territory, including that for electric light and power apparatus, will receive attention.

HIGH VOLTAGE INSULATORS.—Mr. F. M. Locke, of Victor, N. Y., who is now working independently, advises us that he has "a practical high voltage line insulator in which you can get unlimited mechanical strength, puncture test, arcing distance, spray test and creeping surface at a reasonable cost." No other details are forthcoming at the present time.

THE BALL ENGINE COMPANY, Erie, Pa., announces that it has opened a branch office at 39 Cortlandt Street, New York, for the sale of its automatic and Corliss engines. This office will be under the management of Mr. Lancelot Copleston, who is well known to the New York trade. It has also opened a branch office at 1213 Chemical Building, St. Louis, under the management of Mr. O. L. Collins.

WEBER CHIMNEYS.—All the territory hitherto taken care of by the Philadelphia office of the Weber Steel Concrete Chimney Company, of Chicago, at the Land Title Building, will hereafter be attended to by representatives from the New York house under the management of Mr. Thomas C. Maxfield, Singer Building, this city, in addition to the regular New York territory. Mr. T. M. Simpson is no longer in the employ of the Weber Company.

DRIVING CEMENT MACHINERY.—The prevalent practice of using electrical drive for operating cement-making machinery has brought about numerous new applications of the induction motor. The service required of a motor to operate ball and tube mills is very severe, especially as regards starting, when the mass of material must be lifted until a certain point in the revolution has been reached, thus requiring high starting torque. The Allis-Chalmers Company has developed a line of squirrel-cage type induction motors for this particular purpose. The German-American Portland Cement Company, of La Salle, Ill., whose plant is equipped throughout with Allis-Chalmers cement-making and electrical machinery, has recently ordered two additional 5 ins. x 22 ins. Gates tube mills, and a special induction motor which will operate geared to the tube mill at a speed of 660 revolutions per minute.

HARRISBURG ENGINES.—The Harrisburg Foundry & Machine Works, through their St. Louis sales office, the E. H. Abadie Company, have entered into a contract with the United States Government for the manufacture of two twin tandem compound engines of 1000 horse-power each, for installation upon two modern dredge boats to be used in connection with the Mississippi River Commission's work of establishing a channel in our greatest waterway, the Mississippi River. This company has also entered an order from the U. S. Government for a tandem-compound engine of 350 horse-power for direct connection to a 200-kw General Electric generator, to be installed at Panama for use in connection with the work of the Canal Commission at that place. The city of Pasadena, Cal., recently placed a duplicate order for a 500-hp, 4-valve cross compound engine through the company's Pacific Coast representatives, Chas. C. Moore & Co., engineers.

DURABLE FINISH FOR PENDANT SWITCHES.—French Polish Brass is the name of a finish that the Sarco Company, 906 Sixth Avenue, New York City, is applying to its new pendant switch, which it claims is a considerable improvement over the regular polish brass finish. The octagon shape of the Sarco pendant switch readily identifies it from others, together with the concealing of both buttons on the bottom of the switch. This new finish is a series of fine lines covering the entire octagon portion of the switch, which gives it the appearance of an etched surface, and the makers claim that after the switch is lacquered and sent out on the market it can be used and handled, without the lacquer getting spotted through continual use. The switch, with the new movement, the new finish, the automatic locking device to hold the outside shells and the interchangeable bushing for reinforced cord, is in its present form everything that can be desired in devices of this character, and should really be seen to be appreciated. The Sarco Company would be glad to send any large dealers a sample of this latest form of pendant switch to show its customers. It also offers to forward to the trade in general its bulletin No. 10, describing the switch in detail, and copies can be obtained on application.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 19, 1907.

[Conducted by Rosenbaum & Stockbridge, Patent Attorneys, 140 Nassau Street, New York.]

847,305. TELEPHONE SET; George F. Atwood, East Orange, N. J. App. filed March 12, 1906. The combination with a telephone set, of a containing-case therefor, a telephone within the case, a rocking member adapted to receive one end of said telephone, and a latch for the other end thereof.

847,310. THERMO ELECTRIC ANNUNCIATOR; Severin O. Bestul, Iola, Wis. App. filed Oct. 12, 1906. The thermal element is fastened on a supporting frame and has a multiplying lever connection with a pointer which moves between limiting stops adjusted on a thermometer scale.

847,316. TELEPHONE SYSTEM; Charles L. Carr and Thaddeus P. Carr, Yellow Springs, Ohio. App. filed Oct. 10, 1904. Controlling member for party line systems. Has synchronously movable step-by-step devices.

847,337. ELECTRICAL RAIL BOND; Alonzo F. Hooton, Greenfield, Ind. App. filed May 24, 1906. A sheet metal plate is cut and bent so as to closely fit upon the adjoining rails beneath the fish plates which connect them.

847,355. SIGNALING APPARATUS FOR TELEPHONES; August A. Monson, Minneapolis, Minn. App. filed March 31, 1906. In telephony, a substation calling and signaling device, comprising a revoluble disk having a notched periphery, a locking-lever having one end arranged to engage the disk and provided at its opposite end with a projecting arm, and a receiver-hook arranged to engage said arm when depressed and lock said disk from movement.

847,356. AUTOMATIC TELEPHONE-SWITCHBOARD; August A. Monson, Minneapolis, Minn. App. filed April 2, 1906. Relates to modifications of the above.

847,367. TELEPHONE-SWITCH-OPERATING MECHANISM; Frank M. Potter, Jr., Rome, N. Y. App. filed May 28, 1906. The combination of a telephone switch-box, a switch contained therein, a reversible telephone-supporting hook adapted to operate said switch, substantially as described.

847,372. LIGHTNING ARRESTER; Charles A. Rolfe, Adrian, Mich. App. filed Feb. 13, 1903. A plurality of carbon blocks are supported in upright relation on a suitable base and separated by a cement composed of zirconium, magnesia and sesquioxid of manganese.

847,385. TELEPHONE TRUNKING SYSTEM; Harry G. Webster, Chicago, Ill. App. filed Aug. 1, 1902. Details of central exchange and cord circuits of trunking exchange system.

847,424. MEASURING APPARATUS FOR ELECTRICITY; Eduardo M. Y. Miura, Madrid, Spain. App. filed Dec. 12, 1904. A pair of tubular chambers contain electrolyte exposed to equal atmospheric conditions so that the evaporation will be equal. The current to be measured acts only on one tube or chamber so that the current consumption is accurately indicated by the difference in level of the fluid in the two tubes.

847,449. TRANSMITTER-FRONT; Alfred H. Weiss, Chicago, Ill. App. filed Jan. 2, 1907. A transmitter-front having a supporting-rim, integral dampening-spring supports formed thereon and integral bridge-supports formed of an inwardly-bent portion of the rim, substantially as described.

847,461. TELEPHONE-CALL METER; Charles T. Bradshaw, Philadelphia, Pa. App. filed Sept. 27, 1904. In a registering device for telephones a register at the subscriber's station, electromagnetic means for actuating said register from the central station, and means controlled from the subscriber's station for locking said actuating means when the telephone is not in use.

847,506. ORNAMENTAL PRESSED METAL MOLDING; Allen E. Ostrander, Paterson, N. J. App. filed Nov. 19, 1906. Molding construction for electric trains in which the wires are adapted to be compactly run along the sills beneath the roof window sashes.

847,520. CIRCUIT BREAKER; Edwin H. Smythe and Eastman A. Burrows, Chicago, Ill. App. filed April 22, 1905. Details of construction of a circuit breaker having heavy copper brushes which are powerfully pressed toward one another to make the current carrying circuit, and an abruptly movable lever with a carbon block thereon to secure the initial circuit rupture.

847,540. ELECTRIC METER; Claude W. Atkinson, Beckenham, England. App. filed Dec. 29, 1904. Electrolytic meter having a reversing switch adapted to automatically cause periodic reversals which are recorded.

847,546. INSULATOR FOR TENSION GUYS; Alexander E. Brown, Cleveland, O. App. filed Aug. 3, 1906. A strain insulator comprising a rectangular frame with a lateral connecting bolt on which a hollow cylindrical porcelain insulator is mounted and which connects with one guy wire or cable.

847,743. CURRENT CONTROLLER; Richard Duckworth, Preston, England. App. filed Jan. 3, 1906. A form of mechanically actuated switch for sectionally energizing the third rail of an electric railway while the train is passing. Tappet adjacent the track is mechanically depressed by the wheel flanges of the train.

847,746. ELECTRICAL WELDING APPARATUS; Thomas A. Edison, Orange, N. J. App. filed July 21, 1904. Apparatus for welding metallic articles contiguous to a seam thereon, and comprising a carbon operatively mounted in the proper relation to establish an arc between the carbon and the article, and means for rapidly rotating the carbon about its center as an axis, as and for the purposes set forth.

847,750. SLIDING JACK SWITCH; George F. Espy, Union Furnace, Pa. App. filed Nov. 23, 1906. A number of contact blades controlling different circuits project from a block which slides in a groove so that the blades move into engagement with any desired fixed blades.

847,777. TELEPHONIC REPEATING CIRCUIT AND APPARATUS; Fernand E. DeF. d'Humy, Englewood, N. J. App. filed June 26, 1906. In a reciprocal telephonic repeating system, in combination, a divided telephone-line, differential repeating devices, and artificial line-loads, the said artificial line-loads and the sections of the telephone-line being in multiple inductive relation to respective differential repeating devices, as set forth.

847,794. ELECTRICAL APPARATUS; Charles N. Lord, Santa Fé, N. M. App. filed March 7, 1906. A pair of graphite studs project from a handle and constitute the terminals of an electric circuit. In use the graphite studs are merely pressed against an object to be warmed, such as a dental tool.

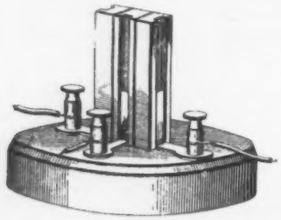
847,842. TELEPHONE-RECEIVER; Louis Steinberger, New York, N. Y. App. filed Aug. 4, 1904. Details of receiver having metallic casing with a U-shaped magnet embedded in cement therein.

847,851. REVOLVING MERCURY DIP CURRENT INTERRUPTER; Francis M. C. Usher, Fulton, Ky., and Consuelo A. Seoane, Merrifield, Va. App. filed Sept. 19, 1905. Interrupter of the type where a plunger is intermittently moved into contact with mercury covered with an oil film to secure rapid interruption of a high potential circuit. Relates to particular features of construction.

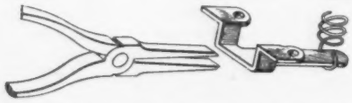
847,877. ELECTRIC-CURRENT INTERRUPTING AND VARYING APPARATUS; Emile Bachelet, New York, N. Y. App. filed Jan. 9, 1906. The combination of a uniformly-operating interrupter, and electro-receptive device, and means for amplifying or changing the number of interruptions transmitted from the interrupter.

847,894. SPARKING DEVICE FOR INTERNAL COMBUSTION ENGINES; Edward F. Bradley, Tufnell Park, London, England. App. filed Feb. 2, 1906. Special construction of vibrator for induction coils having a holding magnet which limits the action to a single spark for each circuit closure by the usual commutator.

847,905. ELECTRIC SIGNAL SYSTEM; Eugenio Chouteau, Jr., St. Louis, Mo. App. filed Oct. 24, 1906. A trolley wire is supported upon the web of the rail and is adapted to be engaged by a specially constructed trolley wheel or shoe depending from an arm on the train. The purpose is to complete signal circuits within the locomotive cab. Has resistance bonds at intervals along the track.



847,372—LIGHTNING ARRESTER.



847,555—ADJUSTING DEVICE FOR RELAYS.

847,794—ELECTRICAL APPARATUS.

847,555. ADJUSTING DEVICE FOR RELAYS; Edward B. Craft, Chicago, Ill. App. filed Feb. 5, 1906. A device for adjusting the tension of the armature of a telephone relay. A bridge fixed to the frame, has an integral tongue to which the spring is attached, and which may be bent to vary the tension of such spring.

847,566. ADJUSTABLE SUPPORT FOR VAPOR LAMPS; Stanwood E. Flichtner, Englewood, N. J. App. filed July 28, 1904. A table or support for a mercury vapor lamp for photographers, etc. The support is tiltable either above or below the level position where it is normally fastened.

847,624. ELECTRICAL MEASURING INSTRUMENT; Thomas W. Varley, New York, N. Y. App. filed Sept. 8, 1905. In an apparatus of the character described, a substantially constant magnet for creating a substantially uniform field of force in a radial direction, a stationary coil adapted to shift the lines of force of the constant magnetic field and a movable coil in the magnetic field normally in a balanced condition relative thereto, but being unbalanced when the magnetic field is shifted.

847,656. TELEPHONE-RELAY; Dilpert S. Dickert, Salt Lake City, Utah. App. filed May 22, 1906. In a relay for telephone-lines, two magnetically-operated transmitting devices respectively shunted across the incoming and outgoing lines, and means to increase the contact resistance of one of said transmitting devices when the other is in operation.

847,663. SPEED CONTROLLING DEVICE FOR ELECTRIC MOTORS; Thaddeus W. Heermans, Chicago, Ill. App. filed Nov. 17, 1906. Circuits for controlling an elevator by movements of the controller arm to either side of a central position.

847,691. TELEPHONE ATTACHMENT; Alcorn Rector, New York, N. Y. App. filed Nov. 24, 1906. The combination with a single receiver having an earpiece, of a ring interposed beneath the earpiece and the body of the receiver, a cup having an earpiece, and a sound-tube leading from within the ring to the cup.

847,701. TROLLEY AND CROSSOVER; Fredrich and Paul B. Schmunk, Beaver Falls, Pa. App. filed July 10, 1906. The harp has unwardly projecting arms with rounded shoes closing over the trolley wire at their extremities. These separate by their resiliency in passing hangers, etc.

847,718. OUTLET BOX AND WALL PLATE; Walter P. Ambos, Cleveland, O. App. filed March 5, 1906. An outlet box of the type contained within a canopy at the base of an electrolier. Has clutch devices embodied therein to which the usual flexible wire connections may be engaged and fastened.

847,728. X-RAY APPARATUS; Eugene W. Caldwell, New York, N. Y. App. filed April 11, 1906. A form of support or stand for X-ray vacuum tubes by which they can be adjusted in any desired vertical relation to a supporting stand on which the photographic negative is placed.

847,741. ELECTRIC HAMMER; Winfield A. Denny, Anderson, Ind. App. filed July 26, 1906. Mechanical features of construction of a small electric hammer having a plurality of solenoid magnets grouped around a common reciprocating part and acting on separate cores projecting from a common yoke.

847,910. PROCESS OF MAKING ARTIFICIAL MICA SHEETS; Edward Cooper, Lower Newton Falls, Mass. App. filed Jan. 10, 1907. Immerses mica scales in shellac bath, then drains them and arranges several thicknesses on a perforated base. The base is then tilted to let the light shine through and disclose weak places which are thereupon remedied.

847,921. OMNIGRAPH; James W. Earles, Fort Hancock, N. J. App. filed Jan. 24, 1907. The key has a swiveling movement in a horizontal plane in addition to the usual movement of depression. The swiveling movement closes circuits which automatically cause particular letters of the Morse code to be sounded, while the vertical movement is employed to practice their repetition.

847,935. ELECTRICAL GROUNDING DEVICE; John F. Golding, Washington, D. C. App. filed Nov. 18, 1905. A long iron spike is vertically grooved with channels in which is fastened by solder or clips, the copper wire or wires to be grounded. The spike is simply driven into the ground carrying the wires with it.

847,937. INSULATED RAIL JOINT; George L. Hall, New York, N. Y. App. filed Oct. 22, 1906. Specially constructed fish plates having sections adapted to dovetail together. Sheets of insulating material are clamped between the sections and bolts with insulating bushings are used for clamping the plates on the rails.

847,939. COMBINED PULL AND KEY SOCKET; John H. Hanson, Chicago, Ill. App. filed July 16, 1906. Form of socket which may be operated either through the instrumentality of the usual turning key or by a pull cord. The switch elements are mounted on a drum spring connected to the spindle having the usual turn button.

847,974. ALTERNATING-CURRENT PLANT COMBINED WITH STORAGE BATTERY; Ludwig Schroder and Adolph Muller, Berlin, Germany. App. filed July 14, 1905. The combination of a direct-current generator, provided with two field-windings in opposition to each other, a storage battery supplied by said direct-current generator and connected with one of said field-windings for energizing the latter, a separate generator connected mechanically with said direct-current generator, and electric mechanism controllable by said separate generator and connected with the other of said field-windings.

847,981. THERMOSTAT; Peabody A. Brown, Denver, Col. App. filed Dec. 8, 1905. A composite strip of brass and steel is vertically supported within a cylindrical casing so as to be deflected to close an alarm circuit in case of excessive temperature.

847,984. TELEPHONE TRUNKING SYSTEM; Francis W. Dunbar, Chicago, Ill. App. filed Aug. 25, 1902. Cord and central exchange circuits for trunking exchange having A and B boards.

847,989. TROLLEY WIRE CROSSING; James N. Hayes, St. Louis, Mo. App. filed Jan. 29, 1906. Designed to form an efficient crossing without interrupting the continuity of the intersecting trolley wires. Employs two castings mortised together with depending ridges which guide the trolley wheel in passing. Has a pyramidal stud at the center which guides the wheel while passing across the usual gap thereat.